FOSTERING TEACHER INNOVATIVE BEHAVIOR THROUGH DESIGN THINKING

by

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Abstract

Many K-12 schools are not preparing students with the 21st century skills needed for success in the knowledge economy. This has created a mismatch between how schools prepare students and the demands of modern employers and society. While the education literature suggests practices and school-wide changes that can foster knowledge economy skills, most schools cling to an antiquated "factory model." In this context, K-12 teachers are reluctant to adopt innovations in their classrooms due to risks associated with trust concerns, change overload, and low creative self-efficacy. This dissertation applies Ford's (1996) theory of individualized creative action and social cognitive theory to address this problem of practice. Over three months, two teams of staff members in one K-8 school were empowered to use design thinking to develop instructional innovations. Design thinking is a problem solving protocol that has been linked to innovativeness and risk taking in the business, engineering, and design literature. A mixed methods study was conducted to explore the impact of the intervention on participants' willingness to take risks and creative self-efficacy via three mediating constructs: knowledge sharing, psychological safety, and climate of innovation.

Quantitative analysis of pre- and post-test data obtained from intervention participants, and a matched comparison group at a sister school, yielded a significant association between the treatment and the climate of innovation scale. Qualitative results found that usage of design thinking, supported by transformational leadership and a blended professional learning community/community of practice structure, increased teachers' creative self-efficacy, willingness to take risks, and innovativeness.

Keywords: design thinking, climate of innovation, teacher risk taking, 21st century skills

Dissertation Adviser: Dr. Henry Smith

Dedication

This dissertation is dedicated to my family. To Alex and Maddie, your empathy, love, humor, and understanding helped me to successfully complete this project. I could not be prouder of who you are and hope this will inspire you to always pursue your passions and dreams. To my best friend and wife, Jen, this would not have been possible without your unwavering support and love. As I sought to balance home, work, and graduate school life, you were my rock and inspiration. I am so fortunate to have you as my partner in life!

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Executive Summary

In recent decades, scholars and industry leaders have expressed concern that K-12 schools in the United States do not adequately prepare students for 21st century employment (Casner-Lotto & Barrington, 2006; Zhao, 2012). Some have argued that an "out-of-date education-employment talent-delivery system" does little to prepare American children for work in a knowledge economy characterized by rapid changes in technology and globalization (Gordon, 2014, p. 3). In particular, many students leave American schools lacking the ability to think creatively, innovatively, flexibly, and collaboratively across cultures (Levy & Murnane, 2013). In the absence of substantial change to the U.S. education system, graduates will struggle to compete in a global employment market that "rewards the innovative and punishes the formulaic" (Wagner & Dintersmith, 2015, p. 197).

What is perplexing is that the education literature is replete with specific strategies for modernizing the education system, yet little has changed in American schools over the past 100 years. Many studies indicate that student-centered strategies like project-based learning (PBL), design thinking, service learning, and the use of maker spaces, provide students with opportunities to deeply explore real world problems (e.g., Henderson, Vogel, & Campagna, 2017; Richards et al., 2013). These strategies have been shown to foster the problem solving skills, critical thinking, innovativeness, and collaboration that are so deeply valued by modern employers. Additional studies provide valuable insight on how schools can foster knowledge economy skills through technology integration, creative scheduling, the development of interdisciplinary courses, and architectural improvements (Bellanca & Brandt, 2010; Landry, 2016; Nair, 2014).

Despite these calls for innovation, schools today look remarkably similar to how they were designed 100 years ago in the Industrial Era. This "factory model" was developed to assimilate waves of immigrants and prepare students for assembly line work through standardized assessment, separation of knowledge into different content areas, and rigid class schedules managed by bells (Leland & Kasten, 2002). The sociological theory of institutionalism provides a lens for understanding why educational change has been stagnant despite the changing demands of employers and society. According to institutionalism, schools are bureaucratic organizations that gain/obtain legitimacy by adhering to organizational norms that form the basis of what is considered to be acceptable schooling (Meyer & Rowan, 1978; Weick, 1976). The validity of schools can be threated if educators deviate from this traditional "grammar of schooling" via innovation (Tyack & Cuban, 1995).

Literature Review

This dissertation begins with a literature review that seeks to inform a problem of practice related to institutionalism: Many teachers decide to avoid, or even resist, being agents of change due to risks they associate with the process of innovation. While risk taking has been widely studied in the fields of psychology, business, and public health, only a few studies exist on the relationship between perceptions of risk and teacher decision-making in schools (Le Fevre, 2014; Tulloch & Lupton, 2003). An examination of research across multiple disciplines revealed that teacher willingness to innovate is particularly influenced by risks they associate with three key factors: a) relational trust concerns; b) change overload; and c) low creative self-efficacy (CSE). First, the literature suggests that trust issues with colleagues, supervisors, or even district administrators, exacerbates natural feelings of uncertainty, threat, and risk teachers feel when engaged in the innovation process (Bryk & Schneider, 2002, 2003). Second, many teachers avoid

change initiatives due to feelings of vulnerability related to change overload. Innovation can feel intolerably risky to overwhelmed teachers who are asked to balance a myriad of (sometimes conflicting) local, state, and federal mandates (Knapp, Bamburg, Ferguson, & Hill, 1998). Third, low CSE (confidence in one's ability to create) impedes teachers from persevering through the challenges that inevitably come up during innovative work (Tierney & Farmer, 2002). Given the pressures imposed by institutionalism, the above three factors play a significant role in impeding school modernization.

Needs Assessment

To gain a deeper understanding of the above problem of practice, and its drivers, the researcher conducted a mixed methods needs assessment in one K-8 public school in New England (Gates School). During the 2015-2016 school year, a survey was conducted with Gates staff members (N = 45), and interviews were carried out with teachers (N = 10) and school/district administrators (N = 8). Using a partially mixed concurrent equal status design, the researcher collected and analyzed quantitative and qualitative data separately, and then triangulated the strands during the interpretation phase. Data indicated that teachers at Gates wanted to innovate their practice but felt prevented from doing so by the presence of change overload, time constraints, pressure related to standardized testing, relational trust concerns, and low CSE. In the interviews, respondents suggested specific steps school leaders must take to overcome these barriers to promote the teaching and learning of knowledge economy skills. Specifically, school leaders would need to develop cultures of innovation that celebrate mistake making, creative efforts, and risk taking. School leadership could also provide the instructional support, time, and resources teachers need for successful innovation. In the absence of these supports, teachers would likely continue to adhere to the antiquated "factory model."

Developing a Design Thinking Intervention

Following the needs assessment, the researcher devised an intervention to promote variables associated with teacher innovativeness. Two design thinking teams at the school were developed to collaboratively solve problems and innovate. Design thinking is a problem solving protocol that has been used in the business, engineering, and design fields to increase risk taking and innovativeness (Brown, 2008; Seidel & Fixson, 2013). It has been cited in the literature as an especially useful practice for group problem solving of complex, ill-defined problems (Martin, 2009). The intervention had three key components, which were carried out over three months: a) the usage of design thinking by team members to solve problems and innovate; b) the presence of a transformational leader to facilitate several design thinking sessions; and c) the use of a blended professional learning community/community of practice (PLC/CoP) structure to support the work.

A theory of treatment (see Appendix D) developed by the researcher suggested that exposure to the three intervention elements would increase two dependent variables associated with teacher innovative behavior—CSE and willingness to take risks (WTR)—via three mediating constructs (opportunities for knowledge sharing, perceptions of a climate of innovation, and psychological safety). To learn about the design thinking process, 11 participants at Gates attended a training facilitated by an external consultant. Afterwards, participants attended six after-school sessions, during which they collaboratively used design thinking to develop instructional innovations and school-wide improvements. For instance, one group used the process to design creative methods for introducing first grade students to the school's new maker space, empowering them to prototype a new architectural space for the school.

Theory Supporting Intervention

The design of the intervention was supported by Ford's (1996) theory of individual creative action (TICA) and social cognitive theory. TICA suggests that human actions in social domains are habitual or creative, and the action one selects is based on a combination of his/her sensemaking, motivation, and knowledge/ability processes (Puente-Diaz, 2016). The theory posits that individuals are most likely to choose habitual over creative action unless they expect more positive consequences for following a creative path. As such, known antecedents to innovation and creativity (e.g., support from transformational leadership and the use of a PLC/CoP structure) were included in the intervention model to inspire desired responses from participants. Another well-established antecedent to creative performance is CSE (Tierney & Farmer, 2002). According to social cognitive theory, one's confidence in their ability to create inspires creative and innovative performance at work (Tierney & Farmer, 2002). In the context of TICA, CSE is a key motivating factor that encourages creative action over a habitual response. With this in mind, the intervention included elements known to increase employee CSE, such as opportunities for knowledge sharing and exposure to a psychologically safe, collaborative environment (Carmeli, Sheaffer, Binyamin, & Shimoni, 2014; Hu & Zhao, 2016).

Implementing and Evaluating the Intervention

A mixed methods study was conducted to evaluate the success of the design thinking intervention. The study used a single case study methodology and a partially mixed concurrent equal status design approach to answer the following research questions:

RQ1: Was the design thinking intervention implemented and delivered as intended?

RQ2: To what degree did participants find the treatment to be useful?

- What do participants report as key strengths and weaknesses to the design thinking approach during the innovation process?

- What do participants report as key barriers to the design thinking process during the innovation process?
- What do participants report as factors that helped them to be successful when using the design thinking approach at Gates School?

RQ3: Were there group differences in reports of CSE and WTR from the beginning to the end of the design thinking intervention?

RQ4: Were there group differences in teachers' perceptions of climate of psychological safety, climate of innovation, and knowledge sharing from the start to finish of the design thinking intervention?

RQ5: Did teachers' perceptions of climate of psychological safety, climate of innovation, and knowledge sharing mediate the association between participation in the intervention and CSE and WTR?

The evaluation study included two equal status strands: a) a process evaluation focused on RQ1 and RQ2; and b) an outcome study based on RQ3, RQ4, and RQ5. The process evaluation portion was conducted with the two design thinking teams to establish whether the intervention was conducted with fidelity. First, quantitative data was collected from participants to measure the extent to which the intervention was carried out as intended by the researcher. Second, qualitative data was obtained through interviews to deeply explore the usefulness of the intervention to participants. The outcome evaluation measured the degree to which members of the intervention groups responded to the intervention relative to a comparison group at a sister school in the district. Quantitative data was collected from the intervention and comparison groups pre-and post-intervention to measure group differences in the dependent and mediating variables. Data from both strands of the study were collected and analyzed separately and then

mixed in the interpretation phase to harness the strengths of the quantitative and qualitative methodologies.

Study Findings

Data obtained through the process and outcome evaluations underscored the potential of design thinking as a driver of innovation and risk taking in a K-12 education setting. In relation to RQ1 and RQ2, the process evaluation found that the study was conducted with fidelity. Of the six indicators of fidelity measured by the study, only one (attendance at the initial training) did not meet the threshold established for high fidelity. Qualitative data collected to inform RQ2 suggested that Gates participants found the intervention to be useful to their innovation efforts. They shared how the iterative approach of interviewing stakeholders for empathy, identifying problems, collaboratively brainstorming with diverse colleagues, prototyping solutions, and trying out innovative ideas enabled them to safely innovate in their classrooms and school. Specifically, teachers benefitted from the iterative nature of design thinking, which allowed them to try out ideas, fail, come back to the group, get new ideas, and try again. They discussed the power of developing an experimental mindset that helped them to take risks in a supportive setting. Moreover, they felt the diverse composition of the group, and support from a transformational leader, helped them to embrace a more innovative mindset that carried over to other aspects of their teaching. However, teachers also discussed some of the challenges that accompanied work on diverse teams and revealed that design thinking may not be an appropriate process for engaging certain tasks (e.g., problem solving related to curriculum teachers perceive to be already successful).

Outcome evaluation results provided information in relation to RQ3, RQ4, and RQ5. While the intervention groups reported net increases for the dependent variables (CSE and WTR)

from the beginning to the end of the intervention, these results were found to be insignificant when comparison group scores were factored into a regression model. In addition, multiple regression analyses indicated that the estimated impacts of the intervention on the mediating variables of knowledge sharing, climate of innovation, and psychological safety were non-significant. Given the small size of the sample, a non-parametric technique (the Mann-Whitney U Test) was applied to compare the distribution of gain scores in the two groups on each outcome. This time, a significant difference was detected between groups for the Culture of Innovate Subscale 2 construct, which focused on teachers' perceptions of the availability of time and resources needed for innovation. It is possible that other associations would have been detected if the sample size had been larger.

While this study was exploratory in nature, the process and outcome results strongly suggest that design thinking, under the right conditions, can be a driver of change and innovation in public schools. For school-based leaders, design thinking can be applied as a tool on academic and school-wide teacher teams to inspire innovativeness and risk taking. Additional research is needed in different contexts, and with larger samples, to detect potential causal relationships and increase the generalizability of findings to others settings. According to Zhao, Zhang, Lei and Qiu (2015), "It is apparent that the traditional teacher-centered pedagogy needs to be changed. It is also more feasible than ever before to make the change. The change is more than piecemeal tinkering. It is a paradigm shift, a complete rethinking of how teaching and learning are carried out" (p. 120). This dissertation establishes that the use of design thinking by teacher teams, supported by transformational leadership and a blended CoP/PLC structure, can play an important role in sparking this much needed paradigm shift.

Chapter 1

Over the past decade, scholars and industry leaders have expressed growing fears that American graduates are entering the workforce ill equipped for 21st century employment (Barell, 2010; Casner-Lotto & Barrington, 2006; Zhao, 2012). In a survey completed by 400 employers across the United States, leaders representing multiple industries expressed concern that far too many young employees lack the ability to solve problems, collaborate with others, and think critically and creatively (Casner-Lotto & Barrington, 2006). A study conducted by Collet, Hine, and du Plessis (2014) revealed a substantial gap "between the skills considered essential for industry activity/success and those evident in recent graduates" (p. 544). Some academics have even raised concern that America's high standing as a global competitor may be at risk given the country's inability to prepare students for emerging jobs (Wagner, 2012).

Since the late 20th century, American public schools have been blamed for not preparing students for economic success. The explicit link between economic prosperity and education is not a new one and was made most publicly in the 1983 report *A Nation at Risk* (Mehta, 2013). This landmark report asserted that American schools were failing students by not preparing them for economic success in the information age. Twenty years later, the Bureau of Labor Statistics indicated that 30 million American were either unemployed or underemployed due to the presence of an "out-of-date education-employment talent-delivery system" (Gordon, 2014, p. 3). They predicted a growing mismatch between available jobs and the skill set of new employees, which they attributed to underlying structural failures in the U.S. education system (Gordon, 2014).

Preparing Students for the "Knowledge Economy"

Numerous scholars across multiple disciplines have made efforts to explain why so many students are not prepared to enter the workforce. The meteoric rise of technology in a global context is frequently cited as the primary reason for this education-employment mismatch. According to Autor, Levy, and Murnane (2003), computers are steadily replacing human beings in tasks that require routine or automated work (e.g., assembly line and customer service positions). Due to globalization, many routine jobs that are candidates for computerization have been moved to the developing world, where low cost labor can be found (Friedman, 2008). As a result of these conditions, human work in the U.S. has shifted to new categories of jobs that computers cannot be programmed to conduct. These "knowledge economy" positions require employees who can think flexibly, solve complex problems, and work with new information (Levy & Murnane, 2013). Without these capabilities, it is argued, American employees will not be able to compete in the global market.

There are a variety of opinions regarding how American K-12 schools can best prepare students for emerging knowledge economy positions. Some scholars point out the need for strong foundational skills in math, English, and technology that serve as a basis for the development of higher order thinking skills (Greenhow, Robelia, & Hughes, 2009; Levy & Murnane, 2013). Other educational experts passionately advocate for explicit teaching of 21st century skills, such as critical thinking, collaboration, creativity, and advanced technology (Cramer, 2007). Proponents of entrepreneurship education argue that schools must encourage students to create and innovate in preparation for future success (Ives, 2011; Zhao, 2012). Lastly, advocates of global education initiatives point out the blurring of international boundaries and advocate for curricula that exposes students to different languages, cultures, regions, and

perspectives (Mansilla & Jackson, 2011; Reimers, 2009). Although there are considerable differences in these various approaches, each one seeks to prepare students for non-routine jobs that require problem solving skills and flexible thinking. From this point forward, the term "knowledge economy skills" is utilized in this dissertation to represent all of the above approaches to supporting students for future success.

Over the past decade, numerous studies have suggested teaching strategies and structural changes in schools that can facilitate the teaching and learning of knowledge economy skills. Some of these studies demonstrate how student-centered teaching strategies like project-based learning (PBL), design thinking, service learning, and the use of tinkering spaces provide students with opportunities to deeply explore real world problems (Henderson, Vogel, & Campagna, 2017; Richards et al., 2013; Sheridan et al., 2014). Research suggests that students engaged in these activities develop key abilities to problem solve, think critically and creatively, work collaboratively, and use technology in authentic contexts (Barell, 2010; Sawyer, 2006). Other studies advocate for technology-rich learning environments in which students can develop confidence with tools they will need in future occupations (Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010). In addition to classroom innovations, schools can support the teaching of knowledge economy skills by creating interdisciplinary courses, developing block schedules that enable student-centered work time, and developing architectural spaces that facilitate collaborative learning (Bellanca & Brandt, 2010; Landry, 2016; Nair, 2014).

The Factory Model

Despite the myriad calls for innovation and reform in America's education system, schools look remarkably similar to how they were designed for the industrial era in the first half of the 20th century. As was the case 100 years ago, common features of the American system

include grading students by age, dividing knowledge into separate subject areas, placing students into compartmentalized rooms with one teacher, teacher-centered approaches to learning, standardized assessment, and rigid class schedules managed by bells (Leland & Kasten, 2002; Robinson & Aronica, 2015; Serafini, 2002; Tyack & Cuban, 1995). Leland and Kasten (2002) outline the purpose and impact of this "factory model" of schooling. According to the authors, the goal of these Industrial Era practices was to assimilate the waves of immigrants entering the United States while preparing them for jobs in factories. In a modern context, these anachronistic assembly line features do not prepare modern citizens to be flexible thinkers in the knowledge economy (Leland & Kasten, 2002; Robinson & Aronica, 2015).

Institutionalism

Some organizational theorists suggest, utilizing the theory of institutionalism, that slow change associated with the factory model of schooling is made possible by traditionalism and institutional conformity that permeates and guides school systems (Meyer, 1977). This theory argues that schools are bureaucratic organizations, which operate under ritual classifications that delineate the roles and actions of students, teachers, and other stakeholders (Meyer & Rowan, 1978). Over time, these rituals have become accepted as organizational norms that form the basis for what is considered to be acceptable schooling, or what Tyack and Cuban (1995) coined the "grammar of schooling" (p. 6). These rules have shaped schools to look more similar than different in a process known as isomorphism (DiMaggio & Powell, 1983). Schools maintain their validity through such bureaucratization, adopting institutional rules and structures that avoid radical changes to curriculum and instruction (Weick, 1976). Innovation can seem challenging, if not impossible, in a bureaucratic system that reinforces conformity and standardization. In his seminal essay on bureaucracy, Max Weber suggested the futility of

reforming bureaucracies, which are "so efficient and powerful a means of controlling men and women that, once established, the momentum of bureaucratization" is irreversible" (DiMaggio & Powell, 1983, p. 147).

The Need for Innovative Teachers

If schools are to transform to meet the 21st century needs of students, teachers must be willing and able to innovate despite the myriad obstacles (Robinson & Aronica, 2015). The term innovation has been defined broadly as "any deliberate attempt to change instruction" (Cohen & Ball, 2000, p. 1). Other definitions focus on the process of innovation, through which "novel ideas are generated, created, developed, applied, promoted, realized, and modified" (Thurlings, Evers, & Vermeulen, 2015, p. 430). For the purposes of this dissertation, the term innovation will refer to deliberate change made to one's instructional practice, or the learning environment, that results in positive outcomes for students. More specifically, this term encompasses pedagogical changes to the learning environment that prepare students for the knowledge economy, alterations to classroom/school spaces that facilitate learning, integration of technology, and any other change to classroom practice that prepares students for the knowledge economy.

Teacher Innovative Behavior

In order to move schools away from the factory model, school leaders must explicitly focus on the innovative behavior of teachers (Thurlings et al., 2015). For multiple decades, the business literature has examined and measured worker innovative behavior (Scott & Bruce, 1994). These efforts recognize the centrality of innovation to the survival of organizations in the global era (Sarros, Cooper, & Santora, 2008). In an educational context, a growing number of scholars are exploring the construct of teacher innovative behavior in an effort to better understand what propels teachers to create and innovate in schools (Thurlings et al., 2015). The

term innovative behavior is defined as "an employee's intentional introduction or application of new ideas, products, processes, and procedures to his or her work role, work unit, or organization" (Yuan & Woodman, 2010, p. 324). Based on the work of Kanter (1988) and Scott and Bruce (1994), this study will conceptualize innovative behavior as both the generation of novel ideas and the implementation (or adoption) of new ideas. One term that is frequently included in the business literature is creative performance, which refers to the ability to generate new ideas. As suggested by the above definition of innovative behavior, creative performance is just one critical component of innovative behavior (Yuan & Woodman, 2010).

Risk Taking and Innovative Teacher Behavior

Recent literature suggests that some teachers may be unwilling to create or adopt instructional innovations that foster knowledge economy skills due to negative risks associated with the process of change. Risk taking is a topic that has been studied by scholars in the fields of entrepreneurship, business, public health, psychology, economics and education (Tulloch & Lupton, 2003). In relation to teachers, only a few articles are devoted to studying how teachers' perceptions of risk may influence decision-making in the classroom. Most of these articles apply the psychological framework of risk-taking, which underscores how perceptions of loss, significance of loss/gain, and uncertainty influence decisions. What emerges from these studies is the idea that innovation can feel intolerably risky to teachers. In his seminal work on self-efficacy, Bandura (1997) pointed out some of the unique challenges of the innovation process, which is often slow, unpredictable, taxing, and highly likely to fail. Innovation can feel especially risky in schools that operate under the rules of institutionalism, which keep the factory model firmly entrenched. Complicating matters is the fact that teachers who enter the field of teaching may be risk-averse in comparison to professionals entering other fields (e.g., law and

business) due to the stability of pay and benefits (Bowen, Buck, Deck, Mills, & Shuls, 2015). Given these factors, it is not surprising that research-driven approaches to supporting 21st century skill development feel risky to teachers. Teachers experience vulnerability when asked to fundamentally change how they teach, organize classrooms, and relate to students (Howard & Gigliotti, 2015; Le Fevre, 2015; Ponticell, 2003). As a result of these perceived risks, examples abound of teachers avoiding or resisting innovations that aim to prepare students for success in the knowledge economy.

Problem of Practice Summary

In summary, education reformers and industry leaders have raised concern that public schools in the United States do not provide students with the skills needed for success in the knowledge economy (Casner-Lotto & Barrington, 2006; Robinson & Aronica, 2015; Zhao, 2012). Due to globalization and rapid advancements in technology, there is increased demand for collaborative, flexible, creative, and globally minded employees. There is also high demand for employees with strong foundational skills in reading, writing, mathematics, and technology. Though research recommends innovative methods and school practices that promote these competencies, many teachers do not adopt them. Teachers may decide to avoid, or even resist, being agents of innovative change in their schools due to risks associated with three key factors explained below: a) relational trust issues; b) change overload; and c) low creative self-efficacy (CSE).

Risk Taking Framework for Understanding Teacher Innovative Behavior

Before examining the three constructs that fuel teacher reluctance to innovate, a framework for risk-taking behavior and a concept map that links factors associated with teacher innovative behavior will be introduced. The concept of risk is all encompassing and has become

an intensely studied construct in a variety of academic fields (Tulloch & Lupton, 2003). In much of the literature, risk-taking behavior and human motivation are considered to be synonymous, and the balance between anticipated reward and risk is examined (Taylor, 2010). Despite the prominence of risk studies across multiple disciplines, the study of teacher risk taking is relatively new, and only a handful of empirical articles exist on the topic. The section below will focus on some general findings in risk literature and then turn to emerging studies on teacher risk taking in relation to innovation and teacher innovative behavior.

The Challenges of Studying Risk: Some Existing Perspectives

Given the highly contextualized nature of risk taking, it is difficult to derive a conceptual framework or theory that applies to all risk-taking situations (Taylor, 2010). As Tulloch and Lupton (2003) explain, risk is grounded in culture and can be viewed as a positive or negative feature of life, depending on the field examining it or the context under study. Complicating matters is the fact that all individuals experience risk differently. As Le Fevre (2014) explains, risk and perceived risk are mental constructions in that "both the adverse nature of particular events, and their probability of occurring can be inherently subjective" (p. 57). The manner in which one evaluates risk depends on past experiences, emotional and physiological reactions, available information, group influences, and social dynamics (Le Fevre, 2014; Trimpop, 1994; Zinn, 2006). With these challenges in mind, a few existing conceptual and theoretical models of risk-taking behavior are presented below.

Risk taking as loss and negative consequences. According to Tulloch and Lupton (2003), risk taking has historically been viewed through a negative lens in the psychology, health, and medical literature. The term risk taking is tightly correlated with words like "sensation seeking", which focus on the tendency of individuals to seek new, exciting, intense,

and potentially dangerous activities (Byck, Swann, Schallet, Bolland, & Mustanski, 2015). Other studies, mainly in the public health and medical domains, equate risk with "hazards" and focus on human decisions to smoke, talk on cell phones while driving, engage in unprotected sex, etc. (Kuntsche & Ravens-Sieberer, 2015). Additional studies from the fields of adolescent behavior and development focus on potentially dangerous decisions teenagers may make at this critical stage of development (Gardner & Steinberg, 2005). Due to the pejorative view of risk in these fields, some definitions of the construct focus exclusively on loss, uncertainty, and danger (Yates & Stone, 1992). Studies of risk in other fields like business and entrepreneurship speak in terms on mitigating risk rather than harnessing the positives associated with risk to create positive outcomes.

In accordance with the historical linking of risk with negative factors, Yates and Stone (1992) developed a risk-taking framework that underscored the centrality of loss, significance of loss, and uncertainty in human decision making. The losses one incurs, be they financial, physical, or social, carry different levels of significance for individuals. The greater the perceived value of the loss, the more risk one assumes when one pursues a certain course of action. As Ponticell (2003) explains, humans will respond with caution, and even resistance, if they believe certain situations will cause significant and important losses. The important role of uncertainty is also considered by Yates and Stone's framework. Risk increases as the odds of a loss occurring combines with greater significance attached to the loss. As will be described at a later point, perceptions of uncertainty dramatically impact the willingness of some educators to adopt instructional innovations in their classrooms (Howard, 2011; Le Fevre, 2014; Ollenbreit-Leftich, Glazewski, Newby, & Ertmer, 2010).

The positive perspective on risk taking. In recent years, there has been more of a focus on how risk-taking attitudes and behaviors can result in personal and organizational gains. Lupton and Tulloch (2002) strongly advocated for risk theories focusing on potential gains and benefits that can accompany risk-taking behaviors. In one study, the authors' interviewed 74 Australians who discussed their experiences with risk and risk taking in everyday life over the course of one year. The stories that emerged from the interviews described how risk-taking decisions provided participants with meaningful opportunities for self-improvement, personal growth, and adventure. With this in mind, Lupton and Tulloch critiqued prior risk research on loss, uncertainty, and emotions as being overly negative. Stalker (2003) contributed to these ideas by advocating for more intensive empirical research on the topic of positive risk taking in the areas of sociology and social work. He developed a continuum of risk that measured not just the hazards associated with risk (on one extreme), but also the positive growth and self-improvement that can occur (at the other extreme).

Studies in the educational, entrepreneurship, and business literature examine how productive risk taking can spur divergent thinking and innovative action (Neves & Eisenberger, 2014; Le Fevre, 2014; Ponticell, 2003). In one study, Kontoghiorghes, Awbrey, and Feurig (2005) sought to determine organizational drivers of innovative action and bottom-line organizational performance. The authors surveyed over 800 employees working in the service and manufacturing industries. They found that organizational practices that encouraged risk taking and new idea promotion predicted innovation and performance. Neves and Eisenberger (2014) supported this finding in their study on the impact of organizational support on employees' willingness to take productive risks. Correlational data collected from 346 employee-employer dyads from diverse organizations indicated that employees who felt valued and trusted

by their organizations were likely to take productive risks that could help their companies innovate and grow.

Dewett (2006) explored the relationship between positive risk taking and creative performance by developing a new scale to measure employees' willingness to take risks (WTR). Dewett (2006) defined WTR as "one's willingness to take risks that are intended to be productive within an organizational environment" (p. 29). In other words, the construct measured the extent to which employees were amenable to the acceptance of uncertainty, loss, or threat while in pursuit of something they perceived to be good. In order to measure the relationship between WTR and creative performance, Dewett surveyed 1164 employees working in a research and development firm in the United States. Dyads comprised of employees and supervisors completed the surveys and the paired data were analyzed using regression analysis. The author found a positive and significant relationship between WTR and employee creativity. This critical finding provided the first empirical support for a claim that had been made anecdotally by creativity scholars for several decades (e.g., Amabile, 1983). Additional studies using the WTR scale have generated similar findings (e.g., Dewett, 2007).

Risk Taking and School Reform

In recent years, several scholars have made the connection between school change efforts and risk-taking (Bryk & Schneider, 2002; Smith & Humberstone, 2018; Fullan, 2015; Le Fevre, 2014). Studies on risk in the context of school reform suggest that teachers may resist change if they perceive the costs to be too high, but they will embark in potentially risky reforms if they feel there will be worthwhile gains in the end (Howard & Gigliotti, 2015; Ponticell, 2003). It is this concept of teacher risk on which this literature review will now focus.

The teacher risk literature. The first article to explicitly examine this topic was Spitzer's (1975) study on the effect of group discussions on teachers' attitudes towards risk taking. In the study, 93 teachers took questionnaires that required them to indicate their attitudes about risk taking. A randomly selected subset of teachers was provided with opportunities to talk about items relating to risk, and after retaking the survey, were significantly more positive about risk taking. Short, Miller-Wood, and Johnson (1991) would later focus on the link between teachers' perception of involvement in decision making at their schools and their understanding of how much their schools valued risk taking. It was found that teachers who were empowered to play key decision-making roles in their schools were more likely to believe that their schools supported experimentation and risk taking.

Scholarly interest in teacher risk taking increased when Ponticell (2003) applied Yates and Stone's risk taking framework to understanding teacher responses to school change. As mentioned before, the framework examines how the elements of loss, significance of loss, and uncertainty influence one's WTR (Yates & Stone, 1992). Ponticell used this framework to examine factors that either enhanced or inhibited the risks four teachers were willing to take as a School Within a School (SWS) initiative was being rolled out in their high school. Interviews were conducted with the teachers and three administrators, and data were coded by each of the psychology of risk components. Ponticell found that teachers feared lower standardized test scores for SWS students and were uncertain about changing relationships with colleagues outside of the program. However, gains associated with building new relationships with SWS students, colleagues, and administrators helped some of them to embrace the risks associated with the SWS change.

Le Fevre (2014) followed up Ponticell's (2003) study by studying the role and impact of risk in teachers' reactions to an innovative literacy program in one elementary school. She used semi-structured interviews and participant observation techniques to find three key concerns associated with the new literacy innovation: De-privatization of practice, reduced use of textbooks, and increased student voice/power in the classroom. The uncertainty associated with these changes caused 11 out of 12 teacher participants in the study to resist the literacy program. However, one teacher was willing to adopt the instructional innovation despite the risks involved. Even though she perceived the same risks as her peers, she was willing to change her practices due to the belief that the program helped students and a strong collaborative relationship she formed with a like-minded colleague.

Some studies examine the role that feelings and emotions play in teachers' decisions to adopt instructional innovations known to promote knowledge economy skills (e.g., PBL). Many of these studies focus on the impact of social anxieties on teachers' willingness to assume risks when conducting constructivist activities like PBL. For instance, Hills (2007) used a risk elicitation tool with 35 pre-service teachers and found that anxiety related to social risks impacted teachers' willingness to talk about, and participate in, constructivist activities. Martell (2014) examined teachers' feelings about classroom management issues that can arise during student-centered, constructivist activities. Martell interviewed three pre-service teachers and found that fears of classroom management challenges prevented them from adopting constructivist classroom practices even when the teachers believed that the practice would be helpful to students. Vulnerabilities associated with classroom management were also cited by Le Fevre (2014) as a key reasons why 11 out of the 12 teachers in her study refused to adopt the

innovative literacy reform. It is clear from these studies that fear of failure and discomfort can serve as barriers to innovation.

This relationship between emotions and risk taking is especially prominent in recent studies that explore the challenges many teachers experience when attempting to integrate technology into their classrooms. Evidence suggests that increased numbers of teachers are experimenting with new technologies, such as laptops, projectors, smart phones, and smart boards. However, many teachers are reluctant to rely on these tools due to uncertainties and anxieties associated with their use (Ertmer et al., 2012; Mueller, Wood, Willoughby, Ross, & Specht, 2008). Some teachers fear that they do not possess the professional confidence to use new tools or fix problems that may interfere with student learning. Other teachers feel concerned that weak infrastructure will cause technologies to fail when needed and therefore resort to traditional paper and pencil techniques (Howard, 2011; Howard & Gigliotti, 2015). Another substantial threat is the perception that technology is dehumanization the classroom by dominating instruction and interaction (Turkle, 2015). In all of these situations, perceived risk of failure outweighs the benefits that come with technological innovation.

Research also suggests that perception of risk, and the associated feeling of uncertainty, strongly influence teacher sense making, action, and learning. Twyford, Le Fevre, and Timperley (2017) used a risk perception lens to explore teacher sense making during a professional development (PD) program. Specifically, the initiative focused on K-12 teachers' understanding and usage of formative assessments with students. Using qualitative methods, the authors examined the experiences of 21 teachers in three schools implementing the PD. When making sense of the PD process at various stages, study subjects reported multiple sources of uncertainty and vulnerability (e.g., concerns about their current levels of knowledge or how they were

viewed by colleagues/supervisors). Additionally, the authors found that teachers who perceived threat or risk during the initiative were likely to take actions to mitigate negative emotions. These actions included outbursts of frustration, seeking of re-assurance from others, excessive preparation, and risk avoidance. For teachers who perceived risk during the PD, their "personal and professional identities were challenged, which in turn escalated their perceived risk, and further reduced their capacity for learning" (Twyford et al., 2017, p. 96). This finding of an inverse relationship between perceived risk and learning is crucial for practitioners and scholars who wish to introduce instructional innovations via PD.

Risk Taking and Innovative Behavior: A Concept Map

Before examining three underlying reasons for why innovation feels so risky to teachers, this section will introduce a concept map that illustrates the factors associated with the problem of practice under study. Appendix A illustrates how perception of risk influences teachers' decisions to create or adopt innovations that enhance students' knowledge economy skills. The shaded circle "perception of risk" is symbolic of the framework for risk taking that will be used to understand the problem of practice. The positive and negative perspectives on risk taking are combined to better understand how relational trust issues, change overload, and low innovation/CSE influence teachers' willingness to innovate. For each of these factors, the framework will be used to examine the extent to which perceived loss, uncertainty, and/or vulnerability may reduce innovative behavior in schools. These factors will also be considered through the lens of institutionalism.

Underlying Factor 1: Relational Trust

One reason why teachers may feel risk-averse when it comes to generating or adopting instructional innovations in their classrooms is the existence of low relational trust in their

schools. Like the construct of risk, trust is defined in several different ways depending on the context and field in which it is being examined (Price, 2012). Journals devoted to business and entrepreneurship frequently view trust as a mediating variable that can either enhance or diminish the bottom line of organizations (Neves & Eisenberger, 2014). An increasing number of studies in the fields of organizational behavior, social psychology, and education investigate the antecedents, as well as the outcomes, of trust across multiple levels of analyses (e.g., teams, organizations, or individuals) (Burke, Sims, Lazzara, & Salas, 2007). These studies examine how trusting relationships can facilitate change, enable productivity, promote employee well-being, and bolster organizational productivity.

A common theme that cuts across most studies on trust is the centrality of risk. In the organizational literature, Johnson-George and Swap (1982) defined trust as the willingness to take risks. The authors, and others who followed them, believed that trust could only exist if important incentives were at stake and if an individual trusting others was aware of the risks involved. In the education literature, Bryk and Schneider (2002) focused on the relationship between trust, risk, and effective school reform, suggesting that "relational trust reduces the risk associated with change" (p. 122). Though risk appears to be a central component in many definitions of trust, there is no one conceptual framework for trust within or across disciplines. Trust is dependent on context and the construct has been studied as an unchanging trait, process, or emergent state depending on the intent of the researcher (Burke et al., 2007).

Trust in Education: Relational Trust

Given this lack of a unifying conceptual framework or theory of trust, eminent scholar Anthony Bryk developed a framework for understanding trust in an educational context. Building on the work of Tschannen-Moran (2001), Bryk designed a construct he called relational

trust (Bryk & Schneider, 2002). Relational trust is built on meaningful relationships between individuals and characterized by the factors of respect, personal regard, competence, and personal integrity (Bryk & Schneider, 2002, 2003). To study relational trust in schools, Bryk and his colleagues conducted a longitudinal study in Chicago Public Schools that involved analyses of data collected from 400 elementary schools and interviews/focus groups in 12 communities over the course of 4 years (Bryk, Sebring, Allensworth, Easton, & Luppescu, 2010). Additionally, Bryk examined survey data collected by the Consortium on Chicago School Research over 6 years (Bryk & Schneider, 2002). Using data collected from these seminal studies, Bryk (and several researchers influenced by his work) explored the characteristics of trust, the benefits of trusting relationships in schools, and the relationship between low relational trust and school reform failures.

The components of relational trust. In their work on trust, Bryk and Schneider (2002) and Tchannen-Moran (2001) analyzed the various features of trusting relationships. In schools (and other organizations), stakeholders (e.g., students, parents, teachers, and principals) have agreed upon roles and dependencies on one another. To achieve desired outcomes (e.g., student learning), all stakeholders must fulfill their roles and remain dependent on one another. This dependence on others creates feelings of vulnerability and risk, with trust being established or lost depending on the extent to which stakeholders fulfill their obligations (Brewster & Railsback, 2003). As a framework, Bryk and Schneider (2002) used the variables of respect, personal regard, competence, and personal integrity to explain when relational trust could be discerned. For instance, they examined two elementary schools (Ridgeway Elementary School and Holiday Elementary) in search of the four elements. Using the case method, they found that relational trust was bolstered in Holiday Elementary by the high personal regard parents,

teachers, and students held for their beloved principal. The principal was highly valued and praised for going above and beyond in his efforts to reach out to stakeholders while cultivating a warm, lively learning environment for students. In contrast, the authors detected low relational trust at Ridgeway School, where the principal's personal integrity was in question (Bryk & Schneider, 2003).

Additional studies have sought to determine the building blocks of relational trust. For instance, Tschannen and Gareis (2015) maintain that trusting relationships between principals and teachers can only exist if they are characterized by benevolence, honesty, openness, competence of the leader, and reliability. Browning (2014) contributed to the literature by examining the trust building practices of four high performing transformational leaders in schools. He identified 10 different trust building practices, which included affirmation, active listening, and the willingness to admit mistakes. Meyer, Le Fevre, and Robinson (2017) explored the interpersonal components of trust by focusing on prior concerns of 27 educational leaders. Each leader responded to a survey and interview questions that elicited information on the history, nature, and causes of a concern with a subordinate. The authors discovered that leaders who communicated their own vulnerability to subordinates in relation to a concern or conflict "promote an environment of trust, which can encourage others to discuss mistakes and failures more openly, rather than avoid them out of fear of emotional reactions" (p. 21). Teachers will be more likely to take risks if the leadership possesses these personal and interpersonal qualities.

Benefits of relational trust. Several studies in the field of education point out the myriad benefits that relational trust can have on change, innovation, academic performance, and employee happiness. Before examining these benefits, it is critical to point out that relational trust is a moderating construct that does not directly influence school improvement, but it

supports the conditions in which outcomes improve. For instance, several studies indicate that relational trust facilitates faculty collaboration, which is known to bolster student academic performance (Tschannen-Moran, 2001). In one study, Hallam, Smith, Hite, Hite, and Wilcox (2015) applied the case study method to determine the role and function of trust in 12 collaborative teams of teachers. Using qualitative methods (e.g., interviews and observations), the authors explored how trust formed on the teams and its impact on teacher collaboration over time. The authors found that trust developed and collaboration significantly increased when team members fulfilled personal responsibilities, shared personal information, and treated one another with patience and kindness. These collaborative relationships can facilitate the transmission of initiatives across schools by creating spaces where school professionals "feel safe to experiment with new practices" and take productive risks (Bryk & Schneider, 2003, p. 43).

Barriers to relational trust. Trusting relationships can be broken when teachers do not discern respect, personal regard, competence, and personal integrity in their peers or supervisors (Schneider & Bryk, 2002). Some additional roadblocks to relational trust include top-down decision making by leaders, ineffective communication, frequent turnover in school leadership, unstable school funding, and teacher isolation (Brewster & Railsback, 2003). Ponticell's (2003) study on the implementation of a small learning community within a large, traditional high school provides an example of how low relational trust can impede school reform. This previously mentioned study tracked the experiences of multiple teachers and administrators as they developed an innovative educational program for a small cohort of academically at-risk students. When interviewed by Ponticell, the teachers shared debilitating trust issues with central office officials. Given the challenges of creating a new program within an established school, the teachers expressed a desire to move slowly and deliberately as they experimented with new

ideas, curriculum, and structures. School-based administrators supported these baby steps, but pressure from the central office for improved test scores pushed teachers to the point of discomfort. This pressure was injurious to teachers' trust of leadership and resulted in "considerable resistance to suggestions to next steps" (p. 15).

Trust and Innovative Behavior

Relational trust issues can be especially problematic when teachers attempt to create or adopt innovative instructional methodologies in their classrooms (e.g., PBL). As Hills (2007) explains, teacher experimentation with instructional innovations can create feelings of social anxiety, insecurity, and vulnerability that can create disagreements between colleagues. Rosenfeld and Rosenfeld's (2006) study on the implementation of PBL in one high school illustrates this point. The authors of the study were invited to the school to mediate tensions among members of a middle school science department who were debating the merits of introducing PBL into the curriculum. Some staff members viewed PBL as a sound strategy for teaching science and preparing students for 21st century learning. Other faculty members disagreed and preferred more traditional pedagogical methods. Relational trust issues existed between staff members who preferred PBL and those who desired more traditional methods. As a result of these issues, there were feelings of animosity and volatility that permeated the science department. The department was only able to move forward with the PBL initiative when relational trust was restored through the study's main intervention. This important study reveals that some teachers will not risk the failures and discomforts that come with innovating their teaching practice in the absence of trusting relationships with colleagues.

In conclusion, trust is the "social glue" that facilitates the innovation process by "helping to counter feelings of vulnerability amid uncertainty" (Lawson et al., 2017, p. 36). On the flip

side, teachers will be less likely to innovate if they experience relational trust problems with their colleagues, school-based leaders, or district administrators (Bryk & Schneider, 2002, 2003). Trust issues can create loss, uncertainty, and vulnerability for teachers (Bryk & Schneider, 2002, 2003). The presence of isomorphic practices associated with institutionalism further increases the risk of change and thereby reduces teacher innovative behavior. In the absence of positive, productive relationships among stakeholders, the factory model of schooling will remain entrenched in American schools.

Underlying Factor Number 2: Change Overload

The existence of change overload in schools may also explain why many teachers choose to avoid instructional innovations. When explaining the challenges experienced by many American teachers, Fullan (2015) wrote, "For most teachers, however, daily demands crowd out serious sustained improvements" (p. 98). Some scholars use the term "intensification of work" to describe the increasing responsibilities, pressures, and challenges teachers wrestle with in their classrooms (Fullan, 2015). One key element of this intensification of teacher workload is the wide range of new, and often conflicting, policies teachers are asked to adopt by school, district, state, and federal officials and agencies. Hargreaves (2008) used the term *initiativiti*s to describe the rate and amount of change teachers are required to take on while Knapp, Bamburg, Ferguson, and Hill (1998) described this phenomenon using the phrase "cumulation and overload" (p. 401). Le Floch, Butler, and Barbour (2017) used the term "throw everything but the kitchen sink" to underscore the well-intentioned but superfluous efforts of administrators and policy makers to improve low performing schools. For the purposes of this literature review, the term change overload will be used because it captures elements from all of the above constructs. This section begins with a general examination of literature that reveals teachers' emotions in the face of

overwhelming change. It will then explicitly link change overload to teacher innovative behavior by focusing on the risks teachers perceive when they attempt to balance accountability mandates with initiatives that aim to prepare students for the knowledge economy.

The Impact of Change Overload on Teachers

Despite evidence of change overload in schools across the country, few empirical studies exist on the topic at the classroom level. The common link between all of the studies is that educators feel overwhelmed by the deluge of multiple, often competing reforms that impact their ability to successfully teach students. Research suggests that teachers will avoid or even resist instructional innovations if they feel overwhelmed by change. In one study, Knapp et al. (1998) examined the consequences of competing reforms in the areas of school governance; curriculum and instruction; and integration of social services. The authors examined the working lives of staff members in one school district in Washington State and found that "expectations, responsibilities, theories and metaphors of change, resources, and contradictions" (p. 409) can accumulate on the plates of exhausted teachers. Grant and Peterson's (1996) study on mathematics reforms in California underscored the challenges three elementary school teachers experienced in this context of systematic reform. Using interviews and classroom observations, the authors discovered that teachers were struggling with change overload. One participant in the study expressed interest in an innovative math curriculum but also felt bogged down by a brand new reading program, a new social studies textbook, an in-service project supporting new readers, and a school level effort to create an ungraded primary program.

The overwhelming nature of change overload can deeply impact the happiness of teachers and cause teacher burnout and turnover. One study that measured the harmful effects of change overload was Valli and Buese's (2007) analysis of teacher roles in one school district

after No Child Left Behind (2001) was ratified. Over a period of 4 years, the authors studied the implementation of one district priority, differentiated instruction, as several other reforms were being implemented (e.g., a new state assessment system, new math and reading curricula, a reading intervention program for low achievers, and inclusion programs for special education students). According to the authors, "teachers were swept up in a flow of mandates that consumed their thinking, their energy, and for some, even their love of teaching" (p. 545). Interviews with teachers across the district revealed that the role expansion and intensification of work impeded teachers' ability to use new curriculum and connect with students. The interviews also revealed high levels of stress and vulnerability as the teachers attempted unsuccessfully to juggle the competing demands of new policies/programs with minimal support and training. As one participant explained, "You're expected to be able to teach the whole program by the next year. Then they change it. And then they throw something else at you…There's a lot of juggling going on…" (p. 549). District-wide high turnover was a tangible result of this palpable stress and dissatisfaction.

Accountability Mandates and Teacher Risk Taking

An in depth analysis of high stakes testing mandates reveals the challenges and risks teachers experience when they try to foster instructional innovations in this climate of change overload. When referring to the high stakes testing movement that accompanied No Child Left Behind in 2001, Valle and Buese (2007) highlighted the myriad policies that bombarded schools. Teachers were confronted with rapid-fire directives that required them to prepare students for new state assessments, meet established adequate yearly progress (AYP) benchmarks, and comply with new standards and curriculum that were aligned with the high stakes exams. According to Valle and Buese, these reforms "promote an environment in which teachers are

asked to relate to their students differently, enact pedagogies that are often at odds with their vision of best practice, and experience high levels of stress" (p. 520). In this context, many teachers feel like they cannot risk the time and energy needed to focus on new 21st century practices (Schoen & Fusarelli, 2008).

In relation to risk studies, high stakes testing environments can create conditions that cause teachers to avoid instructional innovations that may not prepare students for state exams. Schoen and Fusarelli (2008) discuss the impact of direct and indirect fear on teacher decision making in the post-NCLB public school. They argue that fear of student failure, or loss as defined in risk theory, dictates how teachers invest their time and attention. Thus, a teacher may want to include instructional pedagogies like PBL in their classrooms, but may not do so because these practices feel too risky. Teachers may also avoid instructional innovations due to risks associated with angering school or central office administrators. These sentiments were expressed in the aforementioned Ponticell (2003) study. In spite of support from school administrators, the teachers felt insecure about implementing a smaller learning community because they worried that district administrators would punish them for lower standardized test scores.

The consequence of high-stakes mandates and teacher reluctance to innovate in the face of change overload has been the "narrowing of curriculum" in American schools. Curriculum narrowing refers to the increased time and focus that has gone into subjects assessed on high-stakes tests at the expense of non-assessed subjects (e.g., social studies and science), the arts, and less-structured activities like recess (Crocco & Costigan, 2007). One method for evaluating the impact of high-stakes testing policies on teacher practice is by examining how much time schools spent on assessed and non-assessed subjects before and after NCLB. After NCLB was

implemented, schools devoted significantly more time per week on the assessed subjects of English Language Arts and mathematics and less time on social studies, science, physical education, recess, art, music, and lunch (Berliner, 2011; Pederson, 2007).

Several case studies indicate that converging high-stakes policies not only impact time spent on subjects but also pedagogical options teachers perceive they can use in the classroom. In recognition, Crocco and Costigan (2007) expanded the definition of curriculum narrowing to include the reduction of certain teaching practices after NCLB (2001) was enacted. In a phenomenological study, Olivant (2015) focused on the efforts of teachers in one school to use pedagogies that foster creative thinking skills. However, she found that many teachers were stymied in these efforts because they felt the need to use prescribed curriculum and direct instruction to prepare students for state test requirements. Put differently, it was too risky for teachers to utilize teaching strategies like PBL, design thinking, or tinkering spaces. One teacher, Patricia, poignantly described her feelings about these changes: "It's getting to the point where a robot is going to do our job. There's going to be no creativity whatsoever. 'It's getting worse; every year it gets more constrictive'" (Olivant, 2015).

The combination of work intensification and change overload creates a perception of risk that impedes teacher innovative behavior. Teachers may avoid innovation because of the vulnerability that comes with feeling overwhelmed by competing mandates from school, district, state, and federal agencies (Knapp et al., 1998). The threat of developing or adopting an instructional innovation only to have it replaced by new initiatives also decreases teacher innovative behavior (Newmann, Smith, Allensworth, & Bryk, 2001). Finally, fear of loss and punishment associated with low high-stakes scores raises perception of risk and reduces the likelihood of innovation (Ponticell, 2003; Schoen & Fusarelli, 2008). Given these factors, many

teachers choose to adhere to the factory model of education rather than altering their practice to prepare students for the knowledge economy.

Underlying Factor Number 3: Low Creative Self-Efficacy

A third potential driver for teachers' reluctance to innovate is low CSE. Bandura (1977) defined perceived self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). The concept of self-efficacy is grounded in social cognitive theory, which postulates that behavior exists within a triadic reciprocal relationship, which includes cognition, behavior, and environment (Bandura, 1997). Human learning occurs through observation of others, making sense of observations, and reactions to events in an environment. Self-efficacy is one construct that is associated with social cognitive thought. Bandura described the existence of four sources of self-efficacy: Enactive experiences, vicarious learning, social persuasion, and psychological/affective states. Enactive attainment, or the experience of mastery, is considered to be the most important determinant of a person's self-efficacy (Bandura, 1997). The experience of success in a given area raises self-efficacy while perceived failure reduces it. Vicarious experiences involve observation of others modeling an action or behavior. As Bandura explained (1977), observation of others successfully accomplishing a desired act encourages self-efficacy while the observation of failure can have the opposite effect. The third source, social persuasion, focuses on verbal encouragement or discouragement from others (e.g., a supervisor) that may influence one's level of self-efficacy. Finally, perception of physiological factors (e.g., stress) can impact ones belief that he/she will be successful at a given task. Employees take these four sources of self-efficacy into consideration when facing challenges and making decisions (Bandura, 1977).

Self-Efficacy and Innovation

Given the presence of isomorphism in schools and the aforementioned barriers to innovative change, it is important to focus on teachers' confidence in their ability to innovate. Several scholars have anecdotally pointed out the critical importance of self-efficacy to creative and innovative performance in organizations (Bandura, 1997; Mathisen, 2011; Tierney and Farmer, 2002). At the heart of this relationship is the belief that the innovation process is inherently risky, consisting of repeated setbacks, failures, and unknowns. As Bandura (1997) explained,

> Innovativeness requires an unshakeable sense of efficacy to persist in creative endeavors when they demand prolonged investment of time and effort, progress is discouragingly slow, the outcome is highly uncertain, and creations are socially devalued when they are too incongruent with pre-existing ways" (p. 239).

Strong efficacy beliefs help individuals to persevere through challenging situations and cope with the unknown (Bandura, 1977).

Creative self-efficacy. Tierney and Farmer (2002) contributed to the literature by identifying CSE as a critical link in the innovation process. CSE is defined as "the belief one has the ability to produce creative outcomes" (Tierney & Farmer, 2002, p. 1138). According Hu and Zhao (2016) and Choi (2004), CSE motivates employees to persevere through the myriad challenges that inevitably come up during creative work. In the absence of coping strategies and creative confidence, employees may avoid the innovation process (Mathisen, 2011). Several empirical studies have discovered statistically significant relationships between CSE and innovative employee behavior/performance (Choi, 2004; Gong Huang & Farh, 2009; Mathisen, 2011; Carmeli & Shaubroeck, 2007; Tierney & Farmer, 2002). For example, Hu and Zhao (2016) examined CSE in five companies in China. After surveying 274 employee/employer dyads, the

authors found that employees with high levels of CSE were more likely to innovate at work. In an educational setting, Choi (2004) discovered a positive and statistically significant relationship between the CSE of undergraduates and professors' evaluation of creative performance. Given this well-established link between CSE and innovative worker behavior, it can be argued that any intervention that increases CSE may also strengthen innovativeness.

Factors that influence creative self-efficacy. Much of the research on CSE focuses on individual and contextual factors that influence CSE and innovative performance (Farmer & Tierney, 2017). This focus is based on the work of Gist and Mitchell (1992), who argued that individuals evaluate personal (e.g., knowledge) and contextual factors (e.g., a climate conducive to innovation) and rely on these assessments to inform self-efficacy beliefs. The literature identifies several individual and contextual predictors of CSE in different organizational settings. For instance, Tierney and Farmer (2002) found that job tenure, education level, and supervisor support via role modeling and verbal persuasion were instrumental to increased levels of CSE for employees working in a manufacturing and operations division. Mathisen (2011) explored organizational factors that influenced CSE and creative performance in a company in the metallurgy sector. She found that perceived relationships with colleagues and supervisors were related to higher levels of CSE and innovative performance. This knowledge of individual and contextual factors that increase self-efficacy has been used to develop interventions that increase CSE and innovative behavior in business and educational settings (Mathisen & Bronnick, 2009; Ohly, Pluckthun, & Kissel, 2017). In the absence of these, and other factors identified in the CSE literature, it is possible that employees will lack the CSE they need to innovate.

Self-efficacy and risk. Some scholars have attempted to explain how institutional factors increase/decrease self-efficacy and related outcomes (e.g., employee innovation and risk-taking

behavior). For example, Krueger and Dickson (1994) developed a conceptual model that linked self-efficacy to the willingness of managers to make risky decisions. In an experimental study, the authors exposed business students to gambling scenarios that required risky decision-making. Students who received positive feedback on their prior decisions developed increased self-efficacy and were more willing to make risky decision in future gambling scenarios. In this case, positive feedback increase self-efficacy, which helped employees to perceive opportunity and take innovative risks. Conversely, students who received negative feedback were more conservative on future decision-making tasks due to low self-efficacy and the perception of threat. Applied to an educational context, these findings suggest that teachers with low self-efficacy may avoid instructional innovations they perceive to be intolerably risky.

In conclusion, social cognitive theory provides a perspective through which risk-averse behavior and teacher reluctance to innovate can be understood. Bandura's (1977) formative work on self-efficacy revealed the critical link between belief in ability and performance. Tierney and Farmer (2002) contributed to the literature by focusing explicitly on the role CSE plays in the innovation process. In an education setting, teachers may only be willing to assume the unique risks associated with innovation if they possess CSE. In the absence of factors known to promote CSE (e.g., trusting relationships with colleagues and leaders), teachers may choose to adhere to the status quo.

Conclusion

This chapter explained why K-12 teachers are reluctant to initiate or adopt instructional innovations in their classrooms. The theory of institutionalism was introduced as a partial explanation for why the "grammar of schooling" has changed so little over the last 150 years. In addition, a risk-taking framework was introduced to explain how perceptions of loss,

significance of loss/gains, uncertainty, and emotions (e.g., vulnerability) influence teachers' innovative behavior in schools. Using the lens of institutionalism and the risk-taking framework, the factors of relational trust, change overload, and CSE were examined. According to the literature, teachers fear negative judgment from peers and lack of support from administrators if they pursue PBL, design thinking, technology integration, and other practices that foster knowledge economy skills. Teachers are also reluctant to embrace instructional innovations in a system that inundates them with continuous, and sometimes conflicting, policies and initiatives. Lastly, teachers may avoid the innovation process entirely if they lack the CSE needed to navigate the myriad pitfalls, challenges, and uncertainties associated with the creative process. The next chapter will examine the extent to which these three factors, and other potential variables, influence teacher innovative behavior in the author's professional context.

Chapter 2

As the literature review indicated, teachers in K-12 schools are often reluctant to adopt instructional innovations in their classrooms due to perceived risks associated with the constructs of relational trust, change overload, and low creative self-efficacy (CSE). To develop a better understanding of these, and other, potential drivers of the problem of practice, a mixed methods study was conducted at Gates School in the Douglas Public School District. This needs assessment was developed to assess the experiences of staff members at Gates, a K-8 school on the outskirts of a large city in New England. The researcher, who was vice principal at Gates and a former social studies teacher in the school district, constructed the study to answer the following research questions:

RQ1: To what degree do stakeholders at Gates perceive that teachers are innovating their practice in the effort to enhance students' knowledge economy skills?

RQ2: What do teachers and administrators perceive as barriers to innovation at Gates School?

RQ3: How can leaders at Gates create a climate and culture that increases teachers' willingness to take risks (WTR) and innovative teacher behavior?

Context of Study

Before examining the goals, objectives, and methodologies that guided the needs assessment, this section examines contextual factors that may have influenced responses from the two populations under study: Gates teachers and school/district administrators who work directly with Gates faculty. This contextual information is based on the author's experiences as a teacher and administrator in the district and prior day-to-day interactions with staff. During the 2015-2016 school year, Gates was made up of 824 students coming from approximately 450

families. The 85-member faculty worked with a diverse student body, representing over 35 countries of origin and a wide range of socio-economic backgrounds. Due to increases in enrollment over a 5-year period (see Table 2.1), staff members experienced strains related to space availability, scheduling, and growing class sizes.

Table 2.1

School and District 5-Year Enrollment

Location	2016-2017	2015-2016	2014-2015	2013-2014	2012-2013
Gates School	854	824	815	783	752
Douglas School District	7,695	7,668	7,508	7,288	7,112

Contract Dispute in Douglas Public Schools (DPS)

It is possible that teacher and administrator responses to questions asked on the needs assessment instruments were influenced by tensions related to a divisive contract dispute. Over the past few years, the growing student population and intensification of work due to local, state, and national mandates, left many teachers feeling overwhelmed. This issue was exacerbated by a burgeoning English Language Learner population and an unprecedented spike in the number of students presenting with intense social-emotional needs. Teachers felt strongly that they no longer had the time and resources needed to support all learners for success. As a result, they asked the district's school committee for a contract that provided more preparation time during the school day and fewer non-academic duties that reduce time for teaching and learning. For its part, the school committee was reluctant to meet teachers' demands because there was not enough money in the budget to make the proposed changes. At this time, the school committee

was also negotiating with middle management administrators across the district (e.g., vice principals) and paraprofessional aides to update their contracts.

At the time of the initial phase of the needs assessments (March 2016), the contract negotiation process was in its second year and had become negative and divisive. After 1.5 years without a contract, union members voted to take several actions. Teachers were notified that they should not respond to e-mails after contractual hours, leave immediately after school on Mondays, cover up bulletin boards in classrooms, and refuse administrative requests to take on additional responsibilities (e.g., field trips) before and after school. These tactics elicited mixed responses from stakeholders across the district. Some parents and teachers believed that the actions were needed to pressure the school committee, while others felt they were punitive to children and families. Many Gates faculty members felt on edge. As one veteran teacher told the researcher, "A that time, the climate and level of trust in DPS was the worst I've seen in 20 years of teaching" (M. Tucker, personal communication, January 11, 2017).

Many of the actions were rolled back at the beginning of the 2016-2017 school year and the union and school committee came to a preliminary agreement for teachers in September 2016. Middle management administrators settled their contract with the school committee in January 2017. Despite these successes, union leadership did not sign off on the agreements because the paraprofessional contract remained unsettled. When the second wave of data collection for the needs assessment was conducted (February 2017), union officials were considering the possibility of "work to rules." Johnson (2011) defines work to rules as an industrial practice through which employees only complete the bare minimum of work as described in their contracts. This tactic decreases productivity because employees no longer work during lunch, breaks, and before/after work (Johnson, 2011). Many teachers at Gates felt this

action was needed to finalize the paraprofessional contract but feared how it might impact their teaching practice.

Leadership Attrition

A second contextual factor at Gates was leadership attrition at the school and district levels. At the beginning of the 2015-2016 year, the school's veteran principal announced her intention to retire after a 17-year career at the school. This announcement was received with mixed emotions. On the one hand, many teachers felt dismayed that the principal who hired them, a fixture at the school for so long, was departing. Other teachers felt excited about the potential for change that could accompany new leadership. Almost everyone expressed concern over who the new principal might be. At around the same time, the district's superintendent announced his intention to vacate his role (at the end of the school year) in favor of a position in another school district. Following this decision, additional district administrators announced that they, too, would be leaving. With teachers already feeling vulnerable over the contractual stalemate, fears of upcoming leadership transitions at the school and district levels fueled tension and unrest.

Curriculum Conflicts

A third contextual factor that must be considered was the debate over the nature and future of curriculum at Gates. Gates is known and widely respected for its progressive philosophy. However, some teachers feared that the school's values were being eroded by district initiatives that aimed to bolster students' basic skills. The topic of literacy in early education was especially contentious when data were initially collected in March, 2016. Some teachers perceived that changes to the early literacy curriculum were "narrowing out" some play-based learning activities, science and social studies units, and activities devoted to creative thinking

and expression. Several teachers met with the researcher to discuss their concerns with what they perceived to be literacy mandates, and a few staff members refused to adopt components of the new curricula. Many of these teachers expressed deep frustration with what they perceived to be top down mandates from the district office, which appeared to them to be a departure from past practice. From these discussions, it was apparent that frustration over contractual issues and anxiety over leadership turnover were contributing to these curricular tensions.

Teacher Interest in Innovation

Regardless of the above challenges, many teachers at Gates were interested in the prospect of initiating or adopting instructional innovations in their classrooms. When the researcher was employed at Gates between 2014-and 2016, several teachers contacted him to get permission to attend workshops devoted to project-based learning (PBL), technology integration, and design thinking. Bookshelves around the school were filled with books and curricula related to innovative methods for teaching literacy, math, social studies, and science. Over these years, multiple teachers from Gates received grants to purchase 3D printers and other innovative technologies for their classrooms. This raised an interesting question that motivated the researcher's dissertation topic selection: Why are teachers, who appear to be interested in innovating their practice, reluctant to develop and/or adopt instructional innovations? The sections below will seek to address this issue by examining potential barriers Gates teachers perceive when thinking about changing their practice.

Methodology

A mixed methods approach, informed by the worldview of pragmatism, was used to conduct the needs assessment at Gates. According to Cresswell and Clark (2011), pragmatism focuses on the centrality of research questions and the use of multiple methods of data collection

to answer the questions. Mixed methods research questions are vital because they inform what research design is used and help to determine the "type of instruments administered as well as the data analysis techniques used" (Onwuegbuzie & Leech, 2006, p. 475). Based on the questions outlined above, a partially mixed concurrent equal status design was selected by the researcher. Studies that use this design structure prioritize the quantitative and qualitative strands equally and implement both strands during the same phase of the research process (Leech & Onwuegbuzie, 2009). In addition, quantitative and qualitative elements are not mixed until the data interpretation phase of a research project. The strength of this approach is that it enables researchers to triangulate methods while harnessing the benefits and minimizing the weaknesses of qualitative and quantitative methodologies (Johnson & Onwuegbuzie, 2004).

Participants

Gates faculty participants. Participants in the needs assessment were staff members at Gates and DPS administrators who worked directly with Gates faculty. Teachers provided data via an online survey in March 2016. The researcher used availability sampling to select staff members for the survey. Availability sampling refers to the selection of participants in a study on the basis of convenience (Schutt, 2015). For the survey, a total of 45 out of 85 (53%) full-time classroom teachers, specialists, and instructional coaches participated in the study. Out of the 45 respondents, 27 (60%) were classroom teachers (see Table 2.2 below). The term classroom teacher refers to teachers who teach mainstream academic content in self-contained classrooms (at the elementary levels) and single subjects to multiple groups of students (at the middle school level). Respondents in this category teach in all nine grades at Gates and have a range of 1 to 33 years of teaching experience. In addition, 16 respondents to the online survey (36% of the respondents) were specialists. There are three categories of specialists at Gates: Special

education teachers, literacy specialists, and math specialists. Special education teachers work with caseloads of students across the grades in learning centers, while literacy and math specialists support teachers to build capacity and meet with small groups of students in need of services. Staff members in the specialist category are represented in the sample from all grade levels at Gates and bring between 2 to 34 years of work experience. The final faculty group, instructional coach, refers to coaches working in the Enrichment and Challenge Support (ECS) program. Each of the two respondents from this sub-category (4% of the faculty category) has been in the field of education for over 25 years.

Table 2.2

Demographic Characteristics of Teachers in Online Survey (N = 45)

Demographic variable	% (n)
Job title	
Classroom teacher	60.0 (27)
Specialist	35.6 (16)
Instructional Coach	4.4 (2)
Grades work with	
K	33.3 (15)
1	28.9 (13)
2	24.4 (11)
3	31.1 (14)
4	31.1 (14)
5	35.6 (16)
6	31.1 (14)
7	35.6 (16)
8	22.2 (10)
Years Taught	Mean = 13.89; SD = 8.19

Note. School staff could select all relevant grades they work in.

After the needs assessment results were analyzed, the researcher desired more detailed information to better understand the thinking of Gates educators. To this end, a second wave of data collection was conducted with teachers via semi-structured interviews in January 2017. Purposive sampling was used to select 10 veteran staff members, including one recently retired

teacher, one coach, three specialists, and five classroom teachers (representing grades K, 3, 4, 7, and 8). Purposive sampling refers to the method by which participants in a study are selected for a purpose (Teddlie & Yu, 2007). The rationale behind selecting tenured or recently departed staff members for the sample was to mitigate the potential for biased responses due to the researcher's leadership role in the school. The researcher also attempted to reduce bias by randomly selecting from a pool of staff members he was not personally evaluating during the 2016-2017 school year. The names of these teachers (and the retiree who still volunteers at the school) were placed in a hat and selected. Selected teachers were approached via e-mail and invited to an interview (10 out of 11 selected staff members accepted). One limitation of this approach is that it only reflected the perceptions of veteran, tenured teachers. It is also possible that interview responses were still influenced by the researcher's leadership role regardless of the respondents' job security at Gates.

School/District administrator participants. The other respondent group was 8 eight school and district administrators who work directly with Gates faculty. Purposive sampling was used to select administrators who frequently interact with Gates staff around curriculum and instruction issues. At the school level, the principal participated in the study. The principal at the time was had worked at Gates for over 17 years. At the district level, the author collected data from the outgoing deputy superintendent of curriculum and instruction, who was responsible for all curricular decisions across the district. The recently hired director of professional development (PD) for the district also participated in the study. His role was to connect staff members across the district with high quality PD opportunities. Lastly, five of the district's eight curriculum coordinators volunteered to participate in the study. Curriculum coordinators evaluate some staff members and meet frequently with teachers to plan and develop curricular units. In

his capacity as vice principal at Gates, the researcher had professional relationships with all staff members and administrators who participated in the needs assessment. Each of the school leaders selected for the study was either at a parallel or higher level on the administrative hierarchy than the researcher. This selection criteria ensured that respondents would not be influenced by the researcher's position of authority.

Data Collection Methods

There were minimal existing data at Gates that could be collected and evaluated to answer the researcher's primary research questions. Conversations the author held with stakeholders at Gates revealed to him that many teachers were interested in innovating their practice but were impeded from doing so by a variety of barriers. Quantitative and qualitative tools were used to obtain data in the effort to better understand these impediments to change and innovation.

Online survey for teachers. The first instrument used to collect data was an anonymous questionnaire conducted in March 2016 at Gates. The survey was designed to collect information from teachers, specialists, and academic coaches who volunteered to participate in the needs assessment. Since the researcher was in a leadership role at the school and served as evaluator for over 20 staff members, it was critical to ensure the anonymity of respondents' data. To this end, potential subjects were invited to participate in the needs assessment via an e-mail invitation, which included the link to a survey posted on the Qualtrics platform. After clicking on the link, potential volunteers were directed to a brief description of the survey and an Institutional Review Board (IRB) form. At this point, they were prompted to either "agree" or "disagree" to participate in the study.

The online questionnaire included a brief demographic section and three banks of questions that required respondents to select answers from Likert-type scales. The survey asked Gates staff members to answer questions in relation to specific instructional innovations they either wanted to adopt or had been asked to implement by DPS administrators. As mentioned above, most questions in the survey instrument were developed by the researcher to collect information relating to the problem of practice under study. However, multiple questions were either influenced by or taken from existing, validated survey instruments. To gauge the validity of the needs assessment survey, the author asked multiple educators to evaluate the wording and meaning of the questions. Two K-8 teachers in the same school district as Gates and one Johns Hopkins University student involved in the Doctorate of Education (EdD.) program provided valuable feedback. Significant edits were made to the survey based on this input.

Semi-structured interviews with administrators. The second technique used to gather information was semi-structured interviews with 8 administrators in April 2016. Schutt (2015) explains how in-person interviews yield detailed, qualitative data that can augment information obtained from surveys. The researcher asked three interview questions, and follow-up questions when necessary, to the principal at Gates and district leaders who agreed to volunteer for the study. Each interview was designed to take approximately 30 minutes and respondents were provided with the opportunity to review and sign an IRB form prior to the interviews. The researcher visited the school leaders' offices for the interviews and recorded notes using a laptop computer. When taking notes, he attempted to write down quotes that were most relevant to the research questions that guided the study. To enhance the validity and clarity of the interview questions, the researcher asked two graduate students at Johns Hopkins and two curriculum

coordinators from a neighboring (and comparable) school district to provide feedback. Several edits were made to the interview questions based on their comments.

Teacher interviews. After collecting and analyzing data from the online survey and administrator interviews, the researcher interviewed 10 Gates faculty in January 2017 to develop a richer understanding of the staff perspective. The semi-structured interviews included seven questions with follow-up questions when needed. Subjects were invited to review and sign an IRB form and each interview took place in the researcher's office. The interviews were designed to take approximately 20 minutes. In order to increase validity and clarity of questions, the researcher conducted cognitive interviews with two teachers from a neighboring school district with similar demographics and one Johns Hopkins University faculty member. Input from these discussions was used to modify the questions.

Quantitative Measures

The online questionnaire sought to answer the needs assessment research questions through 71 items. Some of the survey questions were taken from validated scales used in prior education, business, and entrepreneurship literature (e.g., questions from the perceived organizational support and failure-related trust scales). Other questions were inspired by existing scales with the wording being modified by the researcher to measure a construct under study (e.g., items from the principal-related trust and district-related trust scales). The remaining items were developed by the researcher to measure additional areas of interest. The literature was used as a guide as these questions were formulated. Face validity was established for the items via cognitive interviews with teachers and doctoral students. Items were combined into scales and tested for reliability, kurtosis, and skewness using the procedures outlined in the data analysis

section. The section below defines each of the scales used in the staff survey and provides basic reliability, validity, and distribution information (see Table 2.3 for construct data).

Table 2.3

Needs Assessment Subscales

Construct	Number of items	Cronbach's α	Kurtosis	Skewness
Perceived Organizational Support	7	.915	1.037	.271
Failure Related Trust	4	.777	-.247	-.521
Principal Related Trust	5	.788	-.716	-.267
District Related Trust	3	.734	.546	-.635
Standardized Tests	5	.785	-.865	.157
Change Overload	4	.896	-.497	.749
Reluctance	3	.842	.492	-.601
Training and Education	5	.811	-.326	.468
Beliefs	11	.823	-1.102	-.336
Pride in School	3	.785	-.748	.034
Risk	8	.830	1.741	-.635

Perceived organizational support. One construct examined in the quantitative portion of the needs assessment was perceived organizational support (POS). POS refers to employees' perception that their organization cares about them and values their efforts (Rhoades & Eisenberger, 2002). Positive relationships have been found between POS, the ability of employees to respond positively to failure, and positive risk-taking behavior in organizations (Neves & Eisenberger, 2014). The researcher included seven items from the POS scale originally

developed by Eisenberger, Huntington, Hutchison, and Sowa (1986) on the staff questionnaire. The items required respondents to agree/disagree to statements using a 4-point Likert-type scale. One question that was slightly adapted to reflect POS in an educational setting was: "My school values my contribution to its well-being." A second question included in the survey was: "My school takes pride in my accomplishments at work." After conducting the survey, the researcher tested the reliability of the construct and found an internal consistency of α=.915. Kurtosis and skewness for the combined POS items were 1.037 and .271 respectively.

Failure-related trust. A second measure borrowed from existing literature focuses on the construct of failure-related trust (FRT). FRT refers to employees' beliefs that an organization will continue to value and support them even after incidents of failure that may negatively impact the organization (Neves & Eisenberger, 2014). In an empirical study, Neves and Eisenberger developed four FRT items in the effort to determine whether FRT mediates the relationship between POS and risk-taking behaviors in organizations. Participants responded to the questions using a 4-point Likert-type scale. One item from the scale was: "I would feel comfortable telling my organization about a mistake I made." A second item was: "If I had a problem that could influence my performance at work, I would discuss it with my administrators." The teachers' results were analyzed and the adapted scale had an internal consistency of α=.777 with a normal distribution of responses (kurtosis =-.257 and skewness =-.521).

Principal-related trust. The researcher adapted the principal-related trust (PRT) scale for use in the needs assessment. Bryk and Schneider (2002) defined PRT as the degree to which teachers perceive that their school-based leaders respect and support their efforts in school. Three items were taken directly from Bryk and Schneider's scale and used to measure teachers' perception of principal trustworthiness on a 4-point Likert-type scale. One sample question was:

"It is ok in this school to discuss feelings, worries, and frustrations with the principal." Two additional items were developed for use in the Gates study to reflect the research interests of the researcher (e.g., "When I feel frustrated with my job, I feel comfortable having a difficult conversation with a Gates administrator"). Internal consistency for the combined PRT scale was α=.788. The distribution scores for the scale were kurtosis=-.716 and skewness =-.267.

District-related trust. Three items were also developed to examine teachers' perceptions of trust between themselves and district administrators (e.g, the superintendent, assistant superintendent, senior directors, etc.). Given the aforementioned leadership changes and tensions at Gates, the researcher aspired to develop a better understanding of how teachers viewed their relationships with the district's top administrators. Wording from the FRT and PRT scales were considered when these items were developed. One sample item was: "I would feel comfortable telling district administrators about a mistake I made." Reliability for this newly developed scale was α=.734 and the distribution of responses was kurtosis=.546 and skewness=-.635. Subsequent to the needs assessment data collection process, Adams and Miskell (2016) released a paper that introduced teacher trust in district administrators as a critical area for future research. The paper introduced a validated district trust measure that will be helpful to future efforts to measure the critical relationship between teachers and district administration.

Standardized tests. Additional items were developed for use on the online survey to measure teachers' perceptions of how standardized testing influences innovative decision-making. Five items were developed based on literature connecting stress associated with preparing students for standardized testing[1] with reduced creative and innovative performance in the classroom (Crocco & Costigan, 2007; Olivant, 2015; Schoen & Fusarelli, 2008). For

[1] The high-stakes standardized test for the state of Massachusetts is called the Massachusetts Comprehensive Assessment System (MCAS).

instance, teacher respondents were asked to rate the extent to which "an instructional innovation they have been reluctant to adopt impedes their ability to prepare students for the MCAS exam." Internal consistency for the combined ST questions was α=.785 and the distribution for responses was normal with kurtosis = -.865 and skewness = .157.

Change overload. The subscale of change overload was developed to measure the impact of change on teacher decision-making and risk-taking. Change overload refers to the feeling of being overwhelmed by cycles of change and reform enacted by school leaders, district leaders, and government agencies (Valli & Buese, 2007; Knapp et al., 1998). As previously discussed, the perception of change overload in schools can reduce teachers' willingness to change their practice (Fullan, 2015; Knapp et al., 1998). Five items were developed to measure change overload on a 4-point Likert-type scale. A sample question from the scale required respondents to rate the degree they agree with the following statement: "I am overwhelmed by the number of changes I am asked to carry out by the school district." Internal consistency for subscale was α=.828 and the distribution for the responses was normal (kurtosis =.713 and skewness =.173).

Resistance/reluctance to change. The subscale of resistance/reluctance to change was developed to measure the extent to which teachers at Gates intentionally obstructed or passively ignored change. Resistance to change has been defined as an "affective, cognitive and behavioral response aimed at maintaining the status quo, with the hope of stopping, delaying or altering the proposed change" (Berkovich, p. 564, 2011). In comparison, reluctance refers to a more passive disinterest in the process of adopting or creating reform (Tallvid, 2016). The education literature points out the importance of understanding teacher resistance/reluctance as impediments to local and comprehensive school reform (Fullan, 2015; Terhart, 2013; Zimmerman, 2006). Three items

were developed with this purpose in mind, including the following example: "I feel reluctant to adopt new instructional innovations requested by the school or school district." Reliability for the resistance/reluctance to change scale was α=.842. The distribution was normal with kurtosis =.492 and skewness =-.601.

Prior training and education. A subscale was also developed to measure the impact of prior training and educational experiences on teacher innovation in the classroom. For the purposes of the needs assessment, prior training and education refers to teachers' exposure to an innovative practice (e.g, a technology) in their own K-12 or higher learning experience or professional development. As stated in Chapter 1, teacher confidence to change and innovate is influenced by prior hands-on and vicarious experiences with innovations under consideration (Bandura, 1997; Hills, 2007; Martell, 2014; Rosenfeld & Rosenfeld, 2006). To examine the impact of prior experience and training on innovative decision-making, five items were developed. For example, staff members at Gates were asked to rate the degree to which they agreed with the following statement: "I did not observe the instructional innovation as a student in my own K-12 and higher education learning experience." Internal consistency for the subscale was strong (α=.811) and the distribution of the curve was kurtosis=-.326 and skewness=.468.

Beliefs about innovation. A subscale was also developed to determine the impact of teachers' beliefs on their willingness to change, innovate, and take risks in the classroom. The construct of beliefs refers to conscious or unconscious assumptions about teaching, learning, students, and curriculum (Fives & Buehl, 2016). The researcher was especially interested in measuring how teachers' beliefs regarding teaching and learning, the value of innovation, and perceived impact of the innovations on future student outcomes (e.g., employment opportunities) influenced decisions to innovate. A subscale consisting of 11 exploratory items was developed to

measure this broad but critically important construct. The items asked teachers to consider an innovation they wished to adopt (e.g., an new assessment technique) and consider the degree to which different beliefs impeded them from doing so. A sample question item from the scale was: "The instructional innovation is inconsistent with my educational beliefs about teaching and learning." A second item was: "This instructional innovation does not provide students with the types of skills they will need for successful 21st century employment." Reliability for the beliefs scale was α=.823. Kurtosis for the distribution of scores was 1.102 with a skewness of .336.

Pride in work. In the effort to gauge teachers' feeling of connection to their jobs, a pride-in-work scale was developed. Pride in work refers to the extent to which teachers feel a sense of connection to their school, school district, and occupation. The questions were not developed based on a pre-existing scale but reflect research that positively relates sense of connectivity to production and innovation at work (Gouthier & Rhein, 2011). Two sample items from the subscale are: "I feel proud to work at Gates" and "I feel proud to work for my school district." Internal consistency for the measure was α=.785 and the distribution of scores was normal (kurtosis=-.746, skewness=.034).

Perception of risk. The final subscale used in the needs assessment measured teachers' perception of risk in areas not already described by the above constructs. Perception of risk refers to teachers' belief that adopting or creating an innovation may result in loss, vulnerability, and/or threat (Yates & Stone, 1992). Two of the questions explicitly include the term risk. For instance, respondents were asked to rate the degree to which they agreed with the following statement: "I am encouraged to take instructional risks at this school." The remaining six questions asked Gates staff members to agree/disagree with statements that suggest risk factors that might preclude them from adopting or initiating an innovation. For example, they were asked to agree

or disagree with the following: “I do not feel confident that the instructional innovation will work.” Reliability for the subscale was α=.830. Kurtosis for the distribution of scores was 1.741 and skewness was -.635. Further development of this scale is needed using factor analysis, which will make the categories within the perception of risk scale more clear.

Survey limitations. It should be noted that several items used in the needs assessment were exploratory in nature and did not fit into the above subscales. These items informed the analysis that follows and helped the researcher to answer the questions under study. However, further work is needed to revise these items to ensure their reliability.

Qualitative Measures

Semi-structured interview questions for administrators and teachers were written by the researcher to augment quantitative data collected via the online survey. A majority of questions were open-ended in nature and designed to elicit emergent themes from respondents. For example, the administrator survey asked respondents to think of an innovation teachers were reluctant to adopt and identify what they perceived to be the barriers to implementation. During the teacher interviews, participants were asked the following: “How can leaders at our school create a more robust climate of innovation?” Although all of the questions on the administrator survey were open-ended, one question from the teacher interview was more specific. Inspired by questions asked by Le Fevre (2014), the researcher asked the following question: “What risks do you think teachers at our school perceive when they think about (or are required to) innovate their practice?” To ensure the trustworthiness (validity) of data obtained through the interview process, several techniques suggested by Nastasi and Schensul (2005) were followed. Data collected from the two sets of interviews were triangulated with one another and compared with the survey results. At the conclusion of each interview, member checking was used to confirm

the interviewers interpretation of responses. Lastly, a reflexive journal was used to document thinking and catch potential biases that emerged during the process.

Data Analysis

Quantitative analysis. For the online questionnaire, the researcher evaluated the survey's reliability and used descriptive and inferential statistics to analyze the results. First, Qualtrics was used to generate a descriptive statistics report that computed averages for closed response questions (e.g., number of years at Gates). The report also indicated percentages of different responses to each question on the survey. The data were then exported from Qualtrics into a statistical package (SPSS Statistics Version 24). Items were combined into subscales and tested for internal consistency. Eleven subscales (described above) with a reliability of .734 or higher were determined through this process. Several exploratory questions did not fit into the 11 subscales but were not dropped from analysis. In addition, kurtosis and skewness statistics were calculated in an effort to determine the score distributions for each subscale. Next, the mean, median, and standard deviation were computed for responses to all questions and subscales. Given the small sample size, inferential statistical analysis was used sparingly.

Qualitative analysis. The researcher analyzed qualitative data at two different points in time as part of his research design. Qualitative data were first examined in April 2016 independent of the quantitative analysis described above. After both strands of data collection were completed and analyzed, the results were then mixed and interpreted together to provide a blended understanding of the data (Cresswell & Clark, 2011). In this first wave of qualitative data collection (from the administrators), the researcher used an inductive approach to identify emerging themes in the administrator responses. First, the researcher examined all of the interview data and recorded initial impressions in his journal. Next, the responses were broken

down into smaller chunks of information, coded, and categorized into themes. The codes were examined multiple times and new categories were generated over time. A reflexive journal was kept throughout this process to assist with the organization of thoughts and track how potential biases might shape data interpretation. Lastly, the researcher quantified the qualitative data to develop a bigger picture understanding of administrator perceptions of the variables under study (e.g., how many administrators perceived trust to be a key barrier to innovation at Gates). Similar steps were followed during the second wave of data collection (from Gates staff members) in January 2017. One key difference was that the researcher first coded the new data using categories established from the first analysis, modified categories when needed, and identified emergent themes when they were discovered.

Findings and Discussion

The following section brings together quantitative and qualitative findings in an effort to better explain the problem of practice. It presents an evidenced-based description of the extent of the problem, as it existed at Gates during the 2015-2016 and 2016-2017 school years. The section is organized around the three research questions that guided the needs assessment and explains the results for each one.

RQ1: To what degree do stakeholders at Gates perceive that teachers are innovating their practice in the effort to enhance students' knowledge economy skills?

One of the main goals of the needs assessment was to identify the extent to which staff members and administrators perceived that teachers were innovating their practice to enhance students' knowledge economy skills. On the questionnaire, 41 out of 45 respondents to the online survey indicated reluctance to adopt an instructional innovation they wanted to adopt at that time. During the two interview phases, teachers and administrators discussed their reluctance to

innovate. One specialist who has worked closely with K-2 teachers at the school said, “Teachers at the school are not the folks who cross their arms in the back of the room because they don’t want to change; they want to innovate but are unable to in this environment” (S. Felix, personal communication, January 12, 2017). Two administrators who have worked closely with teachers at Gates also discussed staff members’ reluctance to innovate despite their desire to do so. One leader said, “Most teachers here are smart and creative and aren’t naturally anti-change. In our current education atmosphere, it’s just challenging at times for them to do” (C. Davis, personal communication, April 6, 2016). The theme that cut across the survey results and interviews with teachers and administrators was that Gates staff members were willing and able to change but held back by a variety of factors.

The results indicated that teachers were especially reluctant to initiate or adopt instructional innovations that foster knowledge economy skills due to the perception of risk. When teachers were asked to rate the extent to which risk aversion stops them from adopting instructional innovations they want to adopt, 19 out of 39 (48%) respondents to this item selected the strongly agreed/agreed ratings. The mean staff response to this question was M=2.78 (SD=.92). It was interesting to note that a significant correlation of .32 (p=.048) was found between teacher risk aversion and years of teaching experience. This correlation revealed that teachers with fewer years of experience were more reluctant to adopt instructional innovations due to perceived risks in comparison to more experienced colleagues. During the interview process, staff members and school leaders suggested that teachers’ WTR is reduced by a variety of factors. For instance, one district leader spoke about the high risks teachers experience when they decided “to move away from district curriculum in favor of project-based learning. They fear getting in trouble with supervisors for not covering content and may avoid 21st century

pedagogies" (R. Farmer, personal communication, April 7, 2016). One of the district coordinators discussed risk-aversion in the context of technology integration. She explained, "Teachers fear technology because they don't think they will get it right…it feels risky so they often won't use it" (A. Griffen, personal communication, April 4, 2016). These statements, and others offered by school/district administrators, revealed that fears and vulnerabilities associated with adopting instructional innovations could serve as significant impediments to change. The following section examines the factors or barriers that made innovation feel intolerably risky to many teachers at Gates.

RQ2: What do teachers and administrators perceive as barriers to innovation at Gates?

Change overload. One key barrier to teacher innovation at Gates was change overload. The mean response to survey questions related to change overload was M=1.88 (SD=.73) on a scale from 1-4 (with 1 indicating that respondents strongly agree that change overload is problematic) (see Table 2.4 below). On one question, 22 out of 28 (78%) of respondents agreed or strongly agreed with the assertion that they avoided instructional innovations because they felt overwhelmed by the myriad changes they are asked to carry out by the school district. Administrators who worked closely with Gates teachers agreed with this concern. One district leader explained, "We are trying to fit way too much in the school day…new initiatives, curriculum, social emotional activities, standardized tests….teachers are feeling overwhelmed" (T. Cunningham, personal communication, April 7, 2016). A coordinator concurred when he said, "We just ask teachers to do so much…it's no wonder they don't feel like they can take on more" (R. Farmer, personal communication, April 7, 2016). Both district level policies and state/federal mandates were blamed for the excessive, competing demands placed on teachers.

Data collected from teachers and administrators also revealed concerns regarding the changing nature of school reforms. In response to one survey question, 25 out of 28 (89%) respondents expressed reluctance to adopt instructional innovations for fear that replacement initiatives would soon follow. A district coordinator put this concern into words by saying, "The initiatives and policies are constantly changing. Why should teachers put time into it if it's going to change anyways" (A. Griffen, personal communication, April 4, 2016). One fourth grade teacher agreed and stated, "There is a huge risk you will start something new and it will be dropped…this inhibits innovation in my classroom" (M. Buck, personal communication, January 12, 2017). High administrative turnover in the district contributed to fears that new initiatives in the context of change overload would be altered when new leadership was hired. On the survey, 19 out of 28 (69%) of respondents strongly agreed/agreed that their reluctance to adopt instructional innovations was due to leadership turnover that could result in prior initiatives being altered. These results indicated that teachers felt overwhelmed by the cycle of change and reform they were being asked to carry out at Gates.

Table 2.4

Descriptive Statistics for Assessment Measures

Construct	Number of items	*M*	Median	*SD*
Perceived Organizational Support	7	1.94	2.00	.487
Failure-Related Trust	4	1.86	2.00	.445
Principal-Related Trust	5	1.92	2.00	.506
District-Related Trust	3	3.20	3.00	.607
Standardized Tests	5	3.00	3.00	.724
Change Overload	4	1.88	2.00	.728

Reluctance	3	2.64	2.83	.703
Training and Education	5	2.14	2.00	.648
Beliefs	11	2.40	2.40	.477
Pride in School	3	1.75	2.00	.543
Risk	8	2.71	2.62	.498

Note. All item responses were on a scale from 1-4, with 1 indicating "strongly agree" and 4 indicating "strongly disagree."

Influence of standardized tests. The influence of standardized tests was identified as a key impediment to innovation in the interviews with teachers and administrators. One veteran teacher discussed a "punishing climate" at the school in which teachers were negatively impacted by the pressures of standardized testing. The teacher shared, "Our test scores are compared around the district and we hear that we might be evaluated based on standardized testing…it's hard to innovate" (R. Taylor, personal communication, January 17, 2017). A second teacher pointed out that teachers put their "reputations on the line" due to the transparency of testing results and would avoid changes to practice that might reduce student scores (M. Springstein, personal communication, January 12, 2017). Curriculum coordinators agreed that the perceived threat of low test scores influenced the willingness of some teachers to innovate. One coordinator explained, "Practices that expose kids to deep learning take time away from preparing kids for skills assessed on the tests" (A. Griffen, personal communication, April 4, 2016). A second coordinator agreed and shared the belief that some teachers "will fear getting in trouble" if their students did worse on state tests and would be reluctant to embrace 21st century teaching practices as a result (E. Marcus, personal communication, April 4, 2016).

There was a discrepancy between what teachers had to say about standardized testing in the online survey and what was shared by the samples of teachers and administrators via the

interviews. The survey included multiple questions that asked teachers to rank the extent to which fears regarding state testing influence pedagogical decisions and time spent on assessed and non-assessed subjects. The mean response for this set of questions was M=3.00 (SD=.72). In response to the teacher practice questions, most respondents indicated that MCAS preparation did not influence how they taught. For instance, one question asked respondents if decisions to not adopt instructional innovations were based on fears that MCAS scores would suffer. In response, 32 out of 39 (82%) participants either disagreed or strongly disagreed with the statement. Responses to other questions relating to MCAS suggested that high stakes exams influenced how much time teachers spent teaching assessed subjects but did not serve as a barrier to the use of instructional innovations. Additional research is needed to determine why teachers on the survey were less concerned about MCAS as an impediment to innovation than the 10 teachers interviewed.

Time. A third barrier to innovation that emerged from the needs assessment survey and interviews was the availability of time that teachers perceived they needed to adopt instructional innovations. For example, one question asked respondents to share whether they have the time they need to implement an instructional innovation they would like to adopt. Despite the fact that respondents were intrinsically interested in the innovation, only 3 out of 39 respondents (8%) felt they had enough time to adopt it. At another point in the survey, 24 out of 28 respondents (86%) strongly agreed/agreed that they did not have enough time to adopt instructional innovations the district asked them to take on. Teacher responses during the interview portion of the needs assessment confirmed these views. One hundred percent of the teacher interviewees shared the concern that lack of time impeded innovation efforts in the classroom. Three of the teachers suggested that it was impossible to innovate during the school year because they only had the

bandwidth and energy needed to innovate during the summer months. As one specialist explained, “How can I possibly even consider changing up what I do if I am already drowning and I don’t have the long stretches of time I need to innovate” (S. Sanders, personal communication, January 17, 2017)?

These time concerns were consistent with the change overload findings explained above and were reinforced by the school leader interviews. As one curriculum coordinator explained, “Many teachers just don’t have the time to learn new pedagogies…they need it explained to them step by step and will avoid it if they don’t have that support” (T. White, personal communication, April 5, 2016). Another coordinator pointed to the critical need for teachers to have time to collaborate. She said, “The time issue totally kills new teaching practices like interdisciplinary teaching. It’s really hard to find time for the interdisciplinary stuff that fuels 21st century learning” (A. Griffen, personal communication, April 4, 2016). In the absence of time, teachers will struggle to initiate and adopt instructional innovations that increase students’ knowledge economy skills.

Relational trust. Teachers also underscored the importance of relational trust to their willingness to take risks and innovate. At the building level, teachers indicated high levels of relational trust with colleagues and school-based leaders on the survey. One item asked teachers to rate the degree to which they felt respected by other teachers at the school. The mean response for the question was M=1.84 (SD.754), with 89.5% of respondents strongly agreeing or agreeing with the statement. Survey responses revealed similar comfort with the administrative team. One question asked staff members to rate the extent to which they felt the principal had confidence in the expertise of the teachers. The mean response was M=1.58 (SD= 552), with 97.4% of participants strongly agreeing or agreeing with the item. Two staff members interviewed from the

sample agreed that relational trust is high across the school but low on a few teacher teams. As one specialist explained, “On teams where the instructors don’t get along as well, teachers are less willing to innovate because they fear judgment from peers” (S. Sanders, personal communication, January 17, 2017). A third grade teacher at the school agreed, sharing, “Teachers on my team are willing to take risks and try something like PBL because we all like each other and the relationships are there. Teachers on other teams won’t put themselves out there if relationship’s not as good” (R. Taylor, personal communication, January 17, 2017). Fifty percent of staff interviewed (5 out of 10) cited their relationship with the principal as a key factor behind their willingness to innovate.

In contrast, school and district leaders who participated in the interviews perceived relational trust to be a significant barrier at the school level. As the outgoing principal explained, “Many teachers are worried about trying something new because what if I walk in and it fails” (C. Davis, personal communication, April 6, 2016). In this scenario, low relational trust (e.g., not feeling comfortable making a mistake in front of an administrator) created a feeling of risk that could impact a teacher’s decision-making around practice. One coordinator explained that poor relationships between colleagues at Gates also created a feeling of intolerable risk that could influence pedagogical decision-making. In making this claim, she cited deep divisions within one grade level team. As she explained, it is hard to be “vulnerable and take risks” when you do not trust the people around you (T. White, personal communication, April 5, 2016).

Teachers and school leaders agreed on the presence of substantial relational trust issues between teachers and district administrators. The mean response to survey questions related to district relational trust was M=3.20 (SD=.61) on a scale from 1-4 (with 1 indicating that respondents strongly agree that change overload is problematic). On one question, 29 out of 37

(78%) respondents disagreed or strongly disagreed with the assertion that they would feel comfortable telling district administrators about a mistake that was made in the classroom. The qualitative portion of the study not only confirmed these poor relationships between Gates staff and district administrators, but also the negative influence of low relational trust on teacher risk taking. In one interview, a curriculum coordinator pointed out the negative climate in DPS and how "teachers feel like district administrators do not have their backs" (R. Farmer, personal communication, April 7, 2016). Another coordinator explained how teachers perceive that high-ranking district officials may punish them for experimenting with innovative pedagogies like PBL that "take time away from the district initiatives, curriculum, and goals" (E. Marcus, personal communication, April 4, 2016). Finally, the principal suggested that teachers may get approval to move forward with an innovative pedagogical practice from the principal, but may still not implement the strategy if they feel unsupported by district administrators. Case studies on teacher risk taking confirm that teachers will be risk-averse in relation to instructional innovations if they do not perceive high relational trust at both the school and district levels (Ponticell, 2003).

Low creative self-efficacy. Data collected from staff and administrator interviews revealed that low CSE impeded teachers from adopting innovations even when they wanted to change their practice. One administrator summed up this problem succinctly when he said, "The issue is confidence! It is hard to risk making changes to your practice if you fear failure" (E. Marcus, personal communication, April 4, 2016). Three Gates staff members pointed out fear of failure and low CSE in the context of change overload and relational trust. One specialist shared, "Teachers here are creative and smart, but they are afraid of putting too much time and energy into something they don't really know how to do well. If a technology fails and they haven't

covered the standards, they are afraid of getting in trouble" (S. Felix, personal communication, January 12, 2017). One teacher made this point by sharing an anecdote about a colleague. She explained how her peer was extremely creative and innovative by nature but felt more risk averse at Gates because she did not know if innovations like PBL, technology integration, and design thinking would actually work. As a new teacher, she felt like the cost associated with wasting time was too high, so she resorted to curriculum and methods that were less creative despite her myriad talents. Finally, low CSE was cited in relation to fears of classroom management challenges. As one teacher explained, "I want to do PBL and use more collaborative methods, but so many more classroom management issues come up when I do" (R. Taylor, personal communication, January 17, 2017). These concerns were consistent with Martell's (2014) finding that fear of classroom management challenges can impede teachers from adopting innovative practices.

Multiple teachers and administrators identified lack of experience with innovations as one reason behind their low CSE. On the questionnaire, 29 of 39 respondents (74.4%) strongly agreed or agreed with the statement that they felt reluctant to adopt instructional innovations they wanted to adopt because they had not received training on how to implement the new practice. Two of the curriculum coordinators suggested that teacher discomfort with innovating their practice stemmed from lack of personal experience with the innovations. One coordinator shared that teachers often lacked confidence with innovations when they never experienced them as K-12, college, or graduate students. She explained, "It can be challenging to facilitate the moving parts of PBL or use new technologies when you were brought up doing something entirely different" (A. Griffen, personal communication, April 4, 2016). A second contributing factor to low CSE at Gates was minimal opportunities for teachers to observe the innovations in practice.

In relation to technology integration, one teacher shared, "I really want to use technology with my kids and know others are doing it…it would really help me if I could see it being done by others before trying it out" (L. Eriks, personal communication, January 18, 2017).

Beliefs about learning and practice. The researcher's interview with one coordinator yielded key information about the relationship between beliefs and teachers' willingness to innovate. The coordinator had been embroiled in a dispute with some early education teachers at Gates for the past 2 years. When asked to explain why some teachers can be resistant to curricular innovations she was proposing, she linked teacher beliefs to risk taking: "The teachers had been doing the same thing for a long time. To suddenly change now is to admit you may have been wrong all along…that feels scary" (T. White, personal communication, April 5, 2016). She went on to explain how changing beliefs can feel especially risky to educators, who so strongly value social justice. "There is so much at stake when you are a teacher because you have a social justice mission…if you believe you have been doing things incorrectly, that may make you feel like you have been harming kids instead of helping them" (T. White, personal communication, April 5, 2016). Thus, it may be easier to keep on doing what you are doing then admitting to past mistakes and changing practice. Two other coordinators explained how innovative practices like PBL felt especially risky because they pushed teachers out of their comfort zones by challenging pre-existing beliefs about teacher-centered practices, classroom organization, and time usage.

RQ3: How can leaders at Gates create a climate and culture that increases teachers' WTR and innovative teacher behavior?

Need for clear vision around innovation. Multiple administrators and teachers pointed out the need for a clearly articulated vision that highlighted the importance of 21st century skills

in DPS. Some of the participants suggested that this vision must come from district level administrators. As one curriculum coordinator explained, "If project based learning and other pedagogies that encourage 21st century skills are going to happen, we need a district vision" (R. Farmer, personal communication, April 7, 2016). A second administrator explained how this vision established at the top reduces risk taking for teachers. With so many initiatives and mandates, a district wide vision would "prioritize" the teaching of knowledge economy skills and reduce the risks of "not focusing as much in the other areas" (C. Davis, personal communication, April 6, 2016). A third leader agreed, suggesting that teacher and administrator teams must also "explicitly write out together what successful 21st century learning looks like…and then we must support them with resources" (T. Cunningham, personal communication, April 7, 2016). These findings reinforced the notion that many teachers wanted to initiate and/or adopt instructional innovations that fostered knowledge economy skills; they were just waiting for the vision, guidance, and support needed to move forward.

Communicating standardized test expectations. As school leaders develop visions that support climates of innovation, they should also clearly communicate their expectations around standardized test performance. As mentioned above, many teachers at Gates did not innovate due to fears of reduced standardized test scores. Two teachers during the interview phase expressed the desire for school leaders to reduce standardized test expectations so they can focus on innovating their practice. One middle school teacher shared, "If someone actually said we don't care about the MCAS scores and backed teachers up if parents expressed concern, that would help us to innovate" (M. Butters, personal communication, January 18, 2017). A specialist concurred, sharing her opinion that the "district needs to clarify its expectations around MCAS…this message needs to be made loud and clear so teachers can feel comfortable

changing" (S. Felix, personal communication, January 12, 2017). Multiple teachers pointed out that any vision that embraces 21st century learning skills must at the least acknowledge that standardized test scores will fall as teachers are experimenting with new technologies and pedagogies. As one veteran teacher explained, "It takes 3-5 years to master something new…my tests scores are going to go down if I'm putting energy into a completely new way of doing things" (R. Taylor, personal communication, January 17, 2017).

Develop a mistake-making culture. Another theme that emerged from the interviews was the desire for a school culture that embraced mistake making. Given the risks involved with innovation and the certainty of mistake making, school leaders can promote creative changes to practice by providing teachers with opportunities to share their errors with colleagues. One specialist suggested that teachers "should be given the chance to present what went wrong with a changed practice to others…and even share videos of mistakes with colleagues and coaches to get feedback" (S. Sanders, personal communication, January 17, 2017). A curriculum coordinator agreed, suggesting that celebration of mistakes during innovation efforts helps to create a "shared philosophy that we are always improving things…it is ok to fail" (R. Farmer, personal communication, April 7, 2016). Lastly, one teacher underscored the critical role of leaders in providing time for teachers to reflect on their failures. By providing time and space for teachers to learn from their mistakes, and the struggles of colleagues, leaders reduce the vulnerability and threat associated with innovative change.

Recognition for innovative work. In addition, school leaders encourage a climate of innovation by recognizing teachers for their accomplishments. One teacher shared an anecdote about her son's principal, who made daily "shout outs" over the loudspeaker to celebrate the efforts of teachers and students in the building. The principal visited classrooms and identified

successful practices observed during the day, including the innovative work of teachers. The teacher mentioned that "this recognition for cool stuff" rewards teachers for thinking outside the box and making changes to their practice that feel risky (S. Felix, personal communication, January 12, 2017). An additional teacher suggested that "positive reinforcement" and "kudos" from school leaders promotes a climate of risk taking that promotes innovation. However, one veteran teacher argued that overt recognition in and of itself is not enough to overcome the risky nature of innovation. Instead, she suggested that schools must include and reward innovative work via the school district's teacher evaluation system. By including measures of innovative change in teacher evaluations, teachers will feel more formally recognized for their change efforts.

Vicarious learning opportunities. School leaders can also promote a climate and culture of innovation by providing opportunities for teachers to observe others. An examination of the teacher interview notes revealed that 7 out of 10 teachers (70%) perceived vicarious learning opportunities as a key to innovative change. Highlighting the risky nature of change, one teacher stated, "Administrators can support risk taking by setting up field trips to see innovation at work. To feel comfortable changing, classroom teachers need to see other classrooms where they can observe how the innovations actually work" (M. Butters, personal communication, January 18, 2017). One early education instructor urged principals to set up "innovation pairing" at Gates, in which teams of teachers can talk to each other about innovation they are trying, observe one another, reflect, and learn (L. Eriks, personal communication, January 18, 2017). Two teachers pointed out the importance of "seeing an innovation like technology before feeling the confidence needed to try it out in the classroom. These comments

were consistent with Bandura's (1997) theory of self-efficacy, which underscores the relationship between vicarious learning opportunities and creative performance.

Empowering innovation "connectors". Respondents also recommended the empowerment of education connectors, who have the capacity to spread innovative ideas across the school. In his critically acclaimed book *Tipping Point: How Little Things Can Make a Big Difference,* Gladwell (2002) introduced the term connector to refer to people with relational talents and influence. Specifically, he defined connectors as "people who link us up with the world…who introduce us to our social circles…with a very special gift of bringing people together" (Gladwell, 2002, p. 38). Two teachers and one curriculum coordinator pointed out the uniquely positive role principals can play in identifying connectors and providing them with opportunities to serve as innovation leaders for their peers. One veteran teacher stated, "You don't need to start all teachers innovating at the same time…just sign up the right people for stuff and watch ideas spread" (R. Taylor, personal communication, January 17, 2017). Another teacher shared that she "feels very nervous" but is open to making changes when she observes a certain colleague on her team innovating her practice (M. Buck, personal communication, January 12, 2017). One curriculum coordinator shared that part of his role is identifying connectors who are willing to "go rogue" and supplying them with the professional development opportunities ad resources they need to serve as examples for colleagues (R. Farmer, personal communication, April 7, 2016). With its knowledge of teacher strengths and relationships, the Gates leadership team is uniquely positioned to select and empower innovation connectors.

Teacher involvement in innovation decisions. Data collected from the interviews revealed that teacher involvement in decision-making around instructional decisions at the school and district levels spurs experimentation and risk taking. According to one coordinator,

teachers would be more likely to risk failure if "they have a seat at the table and help to make instructional decisions" (A. Griffen, personal communication, April 4, 2016). One early education teacher who served with the science coordinator on a district wide curriculum team discussed the relationship between her role on the team and willingness to innovate. The instructor worked with fellow kindergarten teachers to develop a multi-faceted PBL economics unit. She discussed the importance of being involved with the planning of the unit from the outset and the resulting "buy-in" she experienced when the new unit was rolled out. The teacher contrasted this positive experience of initiating and adopting innovative curriculum with the negative experience of being "mandated" to adopt innovations with fidelity by district administrators (L. Eriks, personal communication, January 18, 2017).

Providing time and resources needed for innovation. Teachers also identified several ways school leaders can foster climates of innovation via the provisioning of time and resources. All of the teachers interviewed and three administrators discussed the critical role principals play in securing the time, space, training, and resources teachers need to innovate. One teacher pointed out how school leaders can best support innovative work by carving out time for grade level teams to collaborate with one another and specialists across the school. Curricular resources and materials are also needed as teachers either initiate or adopt innovations. One leader recognized this need and stated, "When you teach something different, you are taking risk. We can help teachers by providing all the materials they need so they feel comfortable knowing what to teach" (E. Marcus, personal communication, April 4, 2016). However, one veteran teacher suggested that school leaders should avoid the urge to micromanage innovation efforts once they are off the ground: "The best leaders are those who create a spirit and the conditions for innovation but then get out of the way so teachers can do the work" (M. Tucker, personal

communication, January 11, 2017). This comment recognizes the delicate line leaders walk as they try to provide meaningful support while nurturing teacher autonomy.

The need for instructional leadership. A final emergent theme discovered during the data analysis stage was teachers' desire for instructional leadership. One teacher described this interest when discussing a visit to Gates by the district's assistant superintendent of curriculum and instruction in 2016. During her presentation to the whole staff, the assistant superintendent mentioned that PBL would be a priority for the district moving forward. When a teacher asked about the impact of changing pedagogy on future MCAS scores, the assistant superintendent shared her belief that using PBL and maintaining high test scores were not mutually exclusive. Ideally, teachers would be able to teach and reinforce the basic skills assessed on the MCAS using pedagogies known to foster knowledge economy skills. During our interview, the teacher responded to this moment by saying, "We are being asked to do something we don't know how to do…we need our leaders to show us how" (M. Butters, personal communication, January 18, 2017). Two middle school teachers revealed some of the challenges principals would face providing this type of instructional leadership across nine levels of learning/curriculum at our school. Once again, teachers at Gates were voicing a willingness to change their practice if provided with the right amount of support and guidance.

Conclusion

This needs assessment used a mixed methods approach to inform the researcher's understanding of the problem of practice under study at Gates. The study was conducted at a time in Gates' history when contextual factors (i.e., a union negotiations conflict, leadership attrition, and curriculum debates) were causing many teachers to feel vulnerable. Data collected from quantitative and qualitative instruments revealed that teachers wanted to innovate and take

instructional risks but felt impeded from doing so by a variety of factors. The needs assessment located several key barriers to innovation at Gates, including change overload, the influence of standardized testing, lack of time and resources devoted to innovation, relational trust concerns, low CSE, and beliefs that inhibited change. During the interview process, Gates staff members and DPS administrators offered concrete suggestions for how these barriers might be removed. To build a robust climate of innovation, leaders must create a transparent vision that embraces the use of knowledge economy skills even if it is at the expense of standardized test scores. Interviewees implored school leaders to develop a school culture that embraces mistake making, celebrates innovation, and nurtures connectors who motivate peers to change. Finally, the stakeholders pointed out that innovative change will only take hold if instructional leaders provide the time, resources, and direct instructional support Gates teachers need to radically alter their practice. These suggestions will be closely considered in Chapter 3 as the researcher examines potential interventions to address the problem of practice under study.

Chapter 3

The following chapter combines information obtained from the literature review and needs assessment to inform an intervention at Gates School. The first chapter identified a problem of practice that is present in American public schools. Many schools are not providing students with the skills needed for success in the knowledge economy (Gordon, 2014; Robinson & Aronica, 2015). Due to rapid advances in technology and globalization, there is increased demand for collaborative, flexible, creative, and globally minded employees (Levy & Murnane, 2013). Although the literature suggests several practices and innovations (e.g., PBL, integrated technology, and maker spaces) that support the learning of "knowledge economy skills", many teachers are reluctant to adopt them (Casner & Barrington, 2006). The sociological theory of institutionalism was applied as a lens for understanding why teachers are reluctant to innovate despite the changing needs of society. Rituals developed in school bureaucracies during the Industrial Era formed the basis for what was considered to be acceptable schooling. In a process called isomorphism, schools were shaped to look more similar than different and school stakeholders were legitimized when they adhered to accepted norms (Di Maggio & Powell, 1983; Weick, 1976). An examination of the business, entrepreneurship, and psychology literature revealed that teachers may avoid, or even resist, instructional innovations due to perceived risks associated with: a) relational trust concerns (Bryk & Schneider, 2002); b) change overload (Valle & Buese, 2008); and c) low creative self-efficacy (CSE) (Hu & Zhao, 2016).

Needs Assessment Results

To develop a contextualized understanding of the problem of practice, the researcher conducted a needs assessment at Gates. This study applied a partially mixed concurrent equal status design to answer three mixed methods research questions. The first question asked

stakeholders to share the degree to which they believe Gates teachers are innovating their practice to prepare students for the knowledge economy. The second question sought to identify barriers to teacher innovation at Gates. Finally, the third question asked stakeholders to make recommendations for how Gates leaders can develop a climate of innovation and risk taking. An anonymous survey and semi-structured interviews with staff and administrators were used to collect data.

Analysis of the data contributed to a rich understanding of the problem of practice at Gates along with potential solutions to the problem. With regards to research question 1, Gates staff and DPS administrators shared that teachers, in general, are not innovating despite a desire to because they feel impeded from doing so by a number of factors. With regard to research question 2, the researcher was able to identify the most salient barriers to innovation at Gates. Stakeholders confirmed and described the presence of the impediments to innovation outlined in the literature review: Relational trust concerns, change overload, and low CSE. Additional barriers to teacher innovation, such as time/resource availability, the influence of standardized tests, and dissonant beliefs about teaching and learning, were uncovered. With regard to research question 3, participants shared several suggestions for how school leaders can encourage risk taking and innovation at Gates. Stakeholders requested a transparent vision for education that prioritizes innovation and deemphasizes preparation for high stakes testing. To accomplish this vision, staff members pointed out the need for adequate time, resources, space, and professional development. Finally, the subjects explained how school-based leaders can facilitate innovative change by providing instructional leadership, celebrating mistakes, publicly rewarding innovation efforts, and empowering teacher "connectors" to be leaders of innovation.

These results, and findings from the literature review, helped the researcher identify two

interrelated constructs that appear to be most responsible for the problem of practice at Gates: Low CSE and limited willingness to take risks (WTR). As previously explained, both of these constructs have been positively related to creative performance and innovativeness in organizations (Hu & Zhao, 2016; Dewett, 2006). Additional evidence suggests that CSE and employee WTR relate to one another in ways that may influence innovative performance in organizations. Bandura (1997) explained how lack of confidence or low CSE reduces one's willingness to accept the substantial risks that accompany innovation. On the flip side, increased CSE propels an employee through the unknowns and vulnerabilities associated with innovation (Dewett, 2006). Before outlining an intervention that applies this knowledge to address the problem of practice at Gates, the researcher will review prior intervention studies that have attempted to increase innovative behavior in schools.

Previous Efforts to Increase Employee Innovative Behavior

Several studies have focused on the extent to which professional development opportunities increase general teacher efficacy or confidence using a specific instructional innovation. For instance, Watson (2006) examined how a series of summer trainings on Internet usage in science and math curriculum influenced the long-term self-efficacy of in-service teachers. The author found that self-efficacy improved after the workshops and persisted years after the program concluded. While Watson's work focused on general self-efficacy, Brinkerhoff (2006) examined the relationship between professional development and self-efficacy in relation to computers. In this case, the author used a mixed methods approach to examine the impact of a long-duration professional development academy on teachers' computer self-efficacy. After experiencing 30 days of professional development across two academic years, the participants' computer self-efficacy increased significantly. This finding confirmed the work of Smith (2001)

and Milbrath & Kinzie (2000), who also found that teachers need time to develop computer self-efficacy. While these studies provided valuable information regarding specific innovations, they did not shed insight into how teacher innovative behavior can be increased.

Moran (2014) sought to fill in this gap by using cognitive learning theory to underscore the importance of observing innovation in action. The main question asked in the study was whether "innovation rounds," a strategy for exposing new teachers to innovative teaching styles, improved the experience of pre-service teachers during their practicum year. The author explored the impact of a program that enabled pre-professional teachers in Australia to participate in innovation rounds, through which the aspiring teachers observed innovative teaching practices. The study focused on the experience of 262 pre-service teachers who were selected by their universities to participate in the observations. Each pre-service teacher visited three sites for a half day, observing an innovative educational practice (determined by the school) in multiple classrooms. At each site, the pre-service teachers were offered opportunities to ask questions to teachers and administrators. They were also provided time for collaborative reflection at the end of each visit. After participating in three innovation rounds, each of the pre-service teachers was surveyed about the impact of the program via an on-line questionnaire. The authors analyzed this survey data and compared it to qualitative data obtained from e-mails, informal meetings, and phone conferences between the teachers and the program facilitators. Pre-service teachers highlighted the myriad benefits associated with observing innovative practices. They learned new ideas, became inspired to try new methods on their own, and developed a better understanding of their own beliefs and orientations towards teaching.

Theoretical Foundation for Intervention

Although prior intervention research provides some helpful suggestions for how the researcher's problem of practice may be mitigated, additional information is needed to address the nuances and complexities of the problem experienced by Gates educators. To develop an intervention that will increase CSE, teacher WTR, and innovativeness at Gates, the researcher explored two theoretical perspectives: The theory of individual creative action (TICA) and social cognitive theory. As will be explained below, TICA provides a general framework in which social cognitive theory can be applied to supporting innovative behavior at Gates.

Theory of Individual Creative Action

Ford's (1996) TICA provides a helpful lens for understanding how a potential intervention can increase innovative behavior. According to Ford, creativity takes place at multiple points during the innovation process and is influenced by different factors at the individual and contextual levels. TICA is based on the premise that human action in social domains is either habitual or creative. The action one chooses in relation to a specific task is determined by the combined influence of sensemaking, motivation, and knowledge/ability processes. For each of these processes, there are certain characteristics that increase the likelihood that an employee will select creative instead of routine action. For instance, a teacher with a problem-finding orientation (sensemaking) who feels rewarded by creative efforts (motivation) and possesses domain related-knowledge (knowledge and ability) in the area of innovation will be more likely to act creatively than someone who lacks these qualities. However, Ford points out that "creative actions are not likely to emerge unless they are expected to present personal consequences that are relatively more desirable than familiar behaviors" (1996, p. 1116). TICA also maintains that creativity occurs in four different social domains

(groups, organizations, institutions, and markets), each of which may impact the ability and willingness of employees to innovate. In order to develop an intervention that will increase teacher innovative behavior, it will be important to focus on the myriad individual and contextual factors that can influence one's decision to choose creative over habitual action.

Social Cognitive Theory

Social cognitive theory rests within the more general TICA framework to inform how organizations can increase innovative teacher behavior. As explained in Chapter 1, social cognitive theory postulates that behavior exists within a triadic reciprocal relationship, which includes cognition, behavior, and environment (Bandura, 1997). Human learning occurs through observation of others, making sense of observations, and reactions to events in an environment. Self-efficacy is one construct that is associated with social cognitive thought. Bandura defined perceived self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (1997, p. 3). Bandura described the existence of four sources of self-efficacy: Enactive experiences (mastery), vicarious learning, social persuasion, and psychological/affective states. In an educational context, teachers who experience these sources are more likely to be confident, persistent, and creative at work despite the risks involved (Bandura, 1997).

The construct of CSE can be explained within the TICA framework as a factor that encourages creative action. According to Puente-Diaz (2016), TICA "conceptualizes creative self-efficacy as a motivational construct with sensemaking and goals as antecedents and with creative and habitual action as two possible consequences" (p. 177). Thus, variables that influence the sensemaking process or motivation in general (e.g., leadership, organizational climate, or opportunities to share knowledge) can potentially increase or decrease CSE. This

nesting of CSE within TICA is critical to the researcher as he conceives of an intervention that seeks to address the problem of practice at Gates. By supporting the antecedents needed for CSE via the intervention, the researcher can encourage creative and innovative action at Gates.

Designing an Intervention at Gates

A goal of the researcher was to develop an intervention at Gates that would promote creative action and innovative teacher behavior despite the perceived risks. An intervention was created that involved design thinking, a problem-solving protocol that encourages experimentation and risk-taking in organizations (Brown, 2009). The intervention also included professional learning communities/communities of practice (PLCs/CoPs) and transformational leadership. In short, the researcher developed two blended professional learning communities/communities of practice (PLCs/CoPs) that used design thinking to promote creative thinking and innovation at Gates. Over the course of 3 months, 11 staff members applied the design thinking protocol to adopt instructional innovations across the school. For instance, one team strategized classroom management practices that supported project-based learning (PBL) while the other team developed innovative approaches to integrating the nascent maker space into daily classroom practice. The team facilitator (who is also the researcher) used transformational leadership practices to develop climates of psychological safety and innovation that encouraged CSE, risk taking, and innovative behavior on the teams.

Intervention Theory of Change

The design thinking intervention was based on a theory of change the researcher developed guided by TICA and social cognitive theory (see Appendix B). According to this theory of change, if transformational leadership practices were used to develop blended design thinking PLCs/CoPs at Gates, then the short-term outcomes of knowledge sharing, climates of

innovation, and psychological safety would be created on the teams. If knowledge sharing, climates of innovation, and psychological safety were created on the teams, then the intermediate outcomes of teacher CSE and WTR would increase. If all of these factors were increased by the intervention, then the two longer-term outcomes of teachers' innovative behavior and students' knowledge economy skills would increase. Given the relatively short duration of the intervention, the researcher was only able to measure the short and intermediate outcomes illustrated on the TOC diagram. However, the following section utilizes the literature to detail how each of the three intervention elements could encourage not only the short and intermediate outcomes, but also the longer-term outcome of increased innovative behavior.

Intervention Component 1: Design Thinking

The first element of the intervention was design thinking, a protocol that has been used in multiple industries to increase creative and innovative performance. As the theory of change illustrates, design thinking is a process that was taught to and then used by members of the blended PLC/CoP teams to achieve the desired outcomes. The section below briefly traces the history of design thinking in the larger context of design studies. It shares competing definitions for the practice before reviewing literature that associates design thinking to the study's long-term outcome of innovative behavior. Finally, the two theoretical frameworks, TICA and social cognitive theory, will be used as lenses to explore how and why design thinking could facilitate creative action and innovativeness at Gates.

Historical Roots of Design Thinking

The use of design thinking in non-design fields is a recent phenomenon that emerged over the past two decades. An important distinction exists between designerly thinking, an academic field that goes back to the 1960s, and the more recent concept of design thinking. The

field of designerly thinking is the academic study of design that seeks to interpret and explain the work of professional designers. For over 40 years, designers and scholars from related fields (e.g., architecture and planning) have sought to better understand the non-verbal work of successful designers (Vogel, 2009). Johansson-Skoldberg, Woodilla, and Cetinkaya (2013) explain how the goal of designerly thinking literature is "purely academic, either understanding for its own sake or for communicating such understanding to students" (p. 124). Designerly thinking is organized into several theoretical perspectives, each with its own scholarly following. In contrast, the term design thinking refers to a "multidisciplinary human-centered approach to innovation, inspired by the ways designers think" (Carlgren, Elmquist, & Rauth, 2016, p. 345). Design thinking is predominantly used in non-design fields like management and engineering. More than two decades ago, scholars from the business and design fields started examining the possibility of utilizing design techniques in non-design occupations. For instance, Herbert Simon (1996) suggested design practices as a potential method for solving complex business problems. The application of design thinking principles in a managerial setting gained popularity in the 2000s due to the work of leaders at the IDEO design firm and business scholars who observed or collaborated with design firms (Brown, 2009; Carlgren, 2013).

Evolution of Design Thinking

As design thinking developed as a practice for driving innovation within business organizations, there was much ambiguity as to what the practice entailed (Johansson-Skoldberg, et al., 2013). Design thinking has been defined in the literature as a way of thinking, mindset, and/or formulaic process through which multidisciplinary teams come up with innovative solutions to problems (Brown, 2008; Dunn & Martin, 2006; Johansson-Skoldberg, et al., 2013). Roger Martin was one of the first business scholars to define the characteristics of design

thinking. Dunn and Martin (2006) compared and contrasted the characteristics of traditional firms and design shops, underscoring the modes of thinking that characterize design work. The authors explained that businesses would be better positioned to innovate if they inspired employees to not only use the deductive and inductive reasoning skills that typify work in modern corporations but also abductive thinking. Abduction refers to the ability to examine a problem and generate one or more ideas for what might be in the future (Dunne & Martin, 2006). The authors recommended that business leaders should emulate the mindset of designers, who view constraints as challenges to be solved via creative thinking rather than undesirable impediments.

Other practitioners and scholars view design thinking as an approach to innovation that includes specific steps and phases. One prominent thinker in this camp is Tim Brown, the CEO and President of IDEO. Brown (2008) defined design thinking as a "methodology that imbues the full spectrum of innovation activities with a human-centered design ethos" (p. 1). Lockwood (2009) expanded this definition by describing design thinking as an "innovation process that emphasizes observation, collaboration, fast learning, visualization of ideas, rapid concept prototyping, and concurrent business analysis, which ultimately influences innovation and business strategy" (p. 5). According to these and other authors, this process empowers heterogeneous groups of employees to deeply explore problems through an iterative sequence of steps or phases (Beckman & Barry, 2007; Brown & Wyatt, 2010). Figure 3.1 (see below) illustrates key steps in the design thinking process: Empathize, define, ideate, prototype, test, and implement. Brown divided these steps into three different phases: Inspiration, ideation, and implementation. During the inspiration phase, team members are motivated to innovate after human-centered approaches (e.g., interviewing stakeholders with empathy) are used to identify

problems and opportunities. In the ideation stage, the group collaboratively brainstorms solutions, develops prototypes, and tests the designs. Implementation involves the final communication and execution of the team's solution. As Brown (2008) points out, design teams cycle through (or iterate) the first two stages several times as they tweak their final product or service. It is this process-oriented definition of design thinking that was used by the two teams at Gates. Staff members selected for the study were introduced to the steps and phases of design thinking via a one-day training facilitated by an outside expert before using the practice to develop instructional innovations in their classrooms.

Figure 3.1 Design Thinking Steps

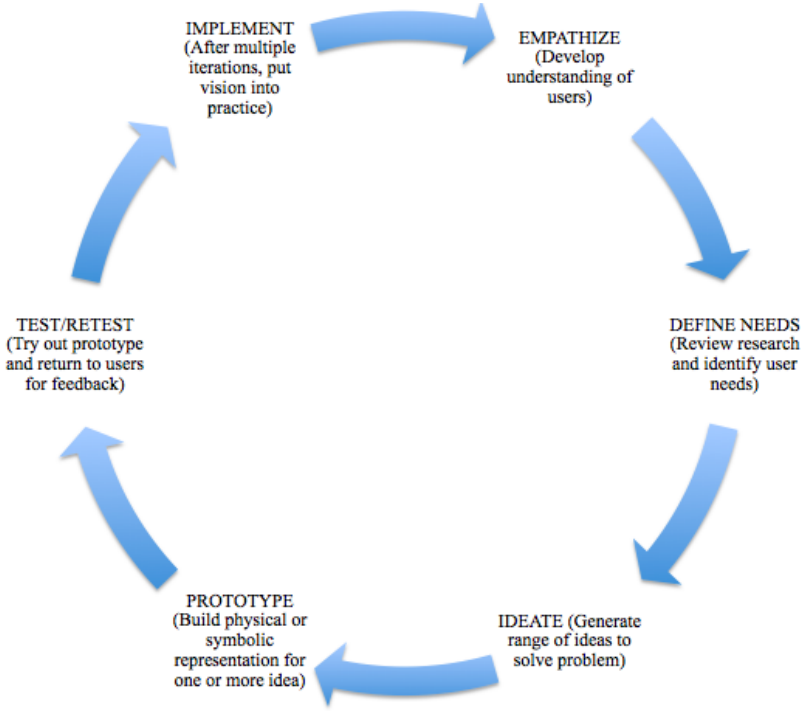

Figure 3.1. The diagram illustrates steps that are followed in the design thinking process. The first 5 steps may cycle (or iterate) multiple times before an innovation is implemented. This chart was based on Brown's (2008) description of design thinking.

Problem solving approach. Although there is some disagreement as to what constitutes design thinking, most practitioners and scholars recognize its usefulness in solving "wicked problems." The term wicked problem was applied by Buchanan (1992) in reference to "problems with a fundamental indeterminacy without a single solution and where much creativity is needed to find solutions" (Johansson-Skoldberg, et al., 2013, p. 125). Martin (2009) viewed wicked problems as mysteries to be solved via inductive, deductive, and abductive reasoning. Brown's (2008) approach embraced the power of applying the design thinking phases to the development of creative solutions to ambiguous problems. As Jakovich, Schweitzer and Edwards (2012) explain, design teams working in organizations will repeatedly proceed through these phases in a non-linear fashion in the effort to resolve wicked problems. Lastly, Schweitzer, Groeger, and Sobel (2016) identified the "mindsets" required for creative and innovative problem solving. For instance, the mindset of acceptance of uncertainty and openness to risk helps design teams to persevere through the fear of failure and unknowns that arise when teams tackle wicked problems.

As design thinking gained popularity as an innovative problem solving approach, Stanford University Design School and the Hasso Plattner Institute developed step-by-step frameworks for design thinking practitioners (Carlgren, Rauth, & Elmquist, 2016). Stanford (2011) offered an online "bootcamp" that provided explicit steps and strategies for practitioners to use in a variety of industries. The bootcamp and other existing guides support design thinking frameworks with a wide variety of tools that can be used to achieve results during all three design thinking phases. For instance, the Stanford Understand Mixtape (2014) offers tools and strategies for interviewing with empathy, assuming a beginner's mindset, selecting "extreme users" to understand needs, and sharing data collected from interviews through a "story share-

and-capture technique." Although most of these tool kits are developed for general use, IDEO (2014) distributed a guide specifically for educators to use with students in K-12 classrooms.

As design thinking has gained popularity as an innovative problem solving approach, it has also received criticism (Nussbaum, 2011). Some critics argue that design thinking processes and tools are not unique and have already been examined in the business, organizational behavior, and management literature (Liedtka, 2015). For instance, the design practice of need finding and its associated ethnography tools are already well grounded in the marketing and business strategy literature. Many books and academic articles have already revealed the benefits of ideation and brainstorming on the creative process (e.g., Seidel & Fixson, 2013). Supporters of design thinking agree that its component parts have been widely studied in the literature. However, when these elements "are combined and viewed together as an end-to-end system for problem solving, design thinking does emerge as a distinctive practice, a bundle of attitudes, tools, and approaches" (Liedtka, 2015, p. 926). A review of the literature reveals that the confluence of elements found in the design thinking approach engenders CSE, risk taking behavior, and innovative behavior.

Design Thinking in the Literature

Anecdotal accounts. Most examinations of design thinking in mainstream books and academic articles describe the practice using the case study method (Brown, 2008; Brown & Wyatt, 2015). For instance, Brown applied the case method to describe how Kaiser Permanente successfully used design thinking to overhaul its nurse shift change process, which was wildly inefficient. Instead of bringing in outside experts, Kaiser empowered its own nurses and doctors to identify the problem, brainstorm solutions, and develop/test prototypes in a risk-free environment. This process invigorated employees and resulted in an innovative new solution that

benefitted nurses and patients. Brown and Wyatt (2010) used similar methods to focus on how the design thinking process can be used to produce innovations that save lives in the developing world.

In their book on the importance of creative confidence to the innovation process, Kelley and Kelley (2013) provided another case study on the usefulness of design thinking. The authors focused on the accomplishments of Doug Dietz, the leader at General Electric who developed magnetic resonance imaging (MRI) systems. Used in a hospital setting, multi-million dollar MRIs enable medical practitioners to view the inside of the body in a painless way. Although the machines were hailed as a medical miracle, some unanticipated problems became apparent when the machines were used to examine children. Dietz learned that many children were terrified by the experience of going inside intimidating machines for long periods of time. After interviewing parents and medical staff, Dietz learned that up to 80 percent of pediatric patients required sedatives when using MRIs. To resolve this problem, he used design thinking to redesign the MRI experience of young patients. He recruited a diverse team of stakeholders, which included employees from GE, medical experts from a children's museum, and medical staff from two hospitals. Empathy and understanding of the problem were gained through observations of students at a daycare center and discussions with child life specialists. Using this iterative process of design thinking, the team ultimately prototyped "Adventure Series" scanners that exposed kids to adventures when inside MRI machines (e.g., being on a pirate ship). The prototypes included colorful visuals, roles for kids to follow while in the MRI, and prizes at the end. As a result of this innovative approach, the number of children requiring sedation decreased and patient satisfaction increased by 90 percent.

Empirical research. Although design thinking research is promising, there is a relative

dearth of empirical studies on its effectiveness in generating positive outcomes across organizations. One of the first quantitative studies on design thinking was conducted by Wattasupachoke (2012), who surveyed 525 business CEOs in an effort to measure the extent to which design thinking principles enhance innovativeness and performance in companies. The author hypothesized that design thinking would contribute to innovation in organizations because the process "stimulates out-of-the-box thinking" (p. 1). After applying structural equation modeling to CEO responses to the survey, the author found that design thinking had a significant impact on the company's innovativeness. Additional empirical articles on design thinking focused on the experiences of graduate design and business students. For instance, Seidel and Fixson (2013) collected data to examine the experience of novice multidisciplinary teams as they attempted to use design thinking to innovate. The authors used a case-based research approach to collect quantitative and qualitative data from interdisciplinary student teams using design thinking at two different universities. They found that design thinking bolstered innovation in both the concept generation and concept selection phases of the process. Additional studies have underscored how the design thinking process can be used to develop new pedagogies and engaging curriculum at the graduate school level (Huq & Gilbert, 2017).

One area that has received empirical attention is perceived barriers to the adoption of design thinking practices. In the context of large businesses, Walters (2011) explained how the design thinking process misaligns with dominant cultures and structures in organizations. For instance, Dunne and Martin (2006) point out how innovation projects developed by teams, instead of managers who are aware of the company's boundaries, may be doomed to fail. With these problems in mind, Carlgren, Elmquist, et al. (2016) examined whether design thinking is a uniquely challenging process, or if perceived barriers may be associated with complexities of the

innovation process previously identified in the literature. The authors interviewed a sample of employees working in five large industrial companies that used design thinking for 5 or more years. The data were coded and seven emergent themes were compared to known impediments to innovation. The authors concluded that some of the themes (e.g., implementing resulting ideas and concepts) "accentuate known challenges, but it also adds complexity in terms of a different communication style, changed power dynamics, and a need for a different type of skill set" (Carlgren, Elmquist, et al., 2016, p. 358).

In the nascent literature, efforts have also been made to define design thinking. Schweitzer, et al. (2016) attempted to define design thinking by identifying the behavioral and cognitive components that make up the design thinking mindset. In this explorative study, the authors interviewed 15 Austrian and German managers who regularly applied design thinking in their innovation efforts. All participants were asked to describe their use of design thinking practices during a specific innovation project and reflect on mindsets they either applied or observed in colleagues. Subject responses were coded, and 11 design thinking mindsets were identified. Based on their qualitative analysis, the authors identified additional mindsets (e.g., accepting of uncertainty and open to risk) that had not been explicitly included in prior literature.

To facilitate future research, Carlgren, Rauth, et al. (2016) used empirical methods to develop a framework that accounted for design thinking as a concept and its practical application. The goal of the authors was to propose "a framing of DT that makes it researchable in both theory and practice, and discussed commonalities and discrepancies in how the concept is usually portrayed in the literature" (p. 38). An exploratory study was developed to measure the experiences of employees working in six companies that have used design thinking techniques for 4-10 years. The aim of the study was to interview subjects and identify similarities and

differences in how employees described their experiences with the design process. The authors then coded interview transcripts and identified five key themes that were connected to a set of mindsets, practices, techniques, and principles. The five themes were: a) user focus; b) problem framing; c) visualization; d) experimentation; and e) diversity. This study contributed scholarly understanding by explaining how design thinking is practiced across organizations and suggesting a structure for studying design thinking. This common language not only supports future efforts to study design thinking but also facilitates comparison to 40 years of research in the designerly thinking field.

Design thinking in the education literature. In recent years, design thinking has been recognized as a viable strategy for teaching students 21st century skills and promoting innovative behavior in K-12 schools (Anderson, 2012). The few existing studies on design thinking in schools focus on design thinking as a pedagogy used to foster creative thinking skills in students. For instance, Carroll et al. (2010) examined the experiences of middle school students and teachers during and after a geography unit that incorporated design thinking. The question under study was: To what extent did students and teachers express their understanding of the instructional strategy of design thinking in a geography classroom context? The study focused on one classroom of 24 middle school students and their classroom teacher. A team of researchers and graduate students from Stanford University worked with the classroom teacher to link design thinking to a unit on the geographic concept of "systems" in the world. Over three weeks, the research team participated as participant-observers during the activity. Students reported that they felt engaged by the opportunity to express themselves creatively through the design thinking process. The teacher concurred that innovative thinking was made possible through the method, but expressed concern that design thinking was ineffective in teaching students the desired

academic content. Additional content specific research studies focus on the impact of design thinking in math and science classrooms (English, King, & Smeed, 2016), writing classes (Leverenz, 2014), the teaching of medieval history (Simkins, 2015), and religious studies (Tan & Wong, 2012).

Seeking to better understand teachers' perceptions of design thinking, Retna (2016) examined the experiences and challenges teachers face when adopting design thinking as an instructional strategy. The author used in-depth interviews and participant observation in one school in Singapore to develop an understanding of how teachers perceive the design thinking process. The findings revealed that teachers view design thinking as a valuable strategy for teaching 21st century skills, such as communication, teamwork, creativity, problem solving, and empathy for others. However, the interviews also revealed several impediments that may derail implementation of design thinking practices in the classroom. The inability of teachers to shift to such a new way of teaching, inadequate resources, and lack of time served as key barriers in the eyes of teachers.

Few articles exist on the role of design thinking on school administrative teams. One example is Rice's (2011) knowledge brief on one school district's use of design thinking to achieve systemic innovation and transformation. Los Angeles Unified School District 4 (LD4) is comprised of diverse stakeholders and included the superintendent, district leaders, multiple principals, teachers, and members of the community. Rice detailed how LD4 specifically used a five-step design thinking process (empathize, define, ideate, create a prototype, and test prototype) to ensure that stakeholders across the district deeply understood its participation in the Linked Learning Initiative. Adopted across the country, the Linked Learning program connects high school students to real world applications via academic instruction and hands-on field

internships. To learn more about how stakeholders in the district understood Linked Learning Initiative, the team conducted several interviews. The data revealed a problem with messaging and communication and the team ideated several potential solutions (e.g., focus groups with end users and radio sessions that shared success stories of students in the program). The team decided to pilot a major convening of all stakeholders at the beginning of the next school year to educate all involved about the initiative. Afterwards, the team reflected on the convening, identified needed adjustments, and planned for the next prototype. Additional research is needed to determine how design thinking might be used to support the work of administrative and teacher teams in schools.

Theoretical Foundation for Design Thinking

Theory of individual creative action. TICA can be applied to understanding how design thinking can be used to encourage teachers' innovative action at Gates. As previously explained, one's decision to act creatively is dependent on the combined influence of sensemaking, motivation, and knowledge/ability. Design thinking arguably favors creative action over habitual action by fostering a problem solving orientation, motivating action (during the empathize and define problems steps), rewarding creativity, and stimulating user curiosity and interest (Ford, 2006). The process of design thinking may also increase teacher innovative behavior by providing opportunities for knowledge sharing. Literature across multiple disciplines points out a strong relationship between innovative behavior in organizations and knowledge sharing (Van Wiljk, Jansen, & Lyles, 2008). Creative thinking and performance rarely occur in the absence of prior content knowledge in the area under study (Hardiman, 2012). Ulrich Kraft (2007) explains this idea, when he writes, "Fresh solutions result from disassembling and reassembling blocks in an infinite number of ways. That means the problem solver must thoroughly understand the

blocks" (p. 17). Innovative behavior increases when organizations provide employees with opportunities to share these "blocks" (knowledge) in a collaborative environment (Van Wiljk, et al., 2008; Yuan & Woodman, 2010). Knowledge sharing stimulates innovation by providing employees with opportunities to build new content knowledge and develop creative ideas with colleagues. These collaborative experiences provide team members with not just the knowledge, but also the confidence they need to navigate through the risks associated with creativity (Hu & Zhao, 2016; Seidel & Fixson, 2013).

Social cognitive theory. At this point, no empirical study exists that links the practice of design thinking to the construct of CSE. However, an analysis of the literature reveals that design thinking could facilitate the aforementioned four sources of self-efficacy. In a description of graduate school design education, Jobst and Meinel (2012) explained how a slow, scaffolded approach to design thinking can engage students in ambiguous problem solving and ultimately open the door to mastery experiences. Teacher members of a design thinking team at Gates may also benefit from vicarious experiences, such as observing exemplar teams as part of a training, watching colleagues on their heterogeneous design teams, or learning from an expert team facilitator (Jobst & Meinel, 2012). Social persuasion, the third driver of self-efficacy, is also encouraged by the design thinking process, as teammates and the group facilitator consistently reinforce one another for taking risks and thinking in a divergent manner (Brown, 2008). Finally, it is possible that design team members will experience an enhanced psychological/affective state from the positive experience of connecting with team members and taking risks in a psychologically safe environment (Kark & Carmeli, 2009). An exploratory study is needed to determine the extent to which design thinking taps into the four sources of CSE.

Intervention Component 2: Blended PLCs/CoPs

The intervention exposed teachers to design thinking through a blended PLC/CoP structure. PLCs are defined as any group of people who share and analyze their practice in "an ongoing, reflective, collaborative, inclusive, learning-oriented, growth-promoting way" (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006). There is some disagreement over the size, scope, and role of PLCs in schools. Dufour (2004) explains how academics and educators alike "overuse the concept to highlight every imaginable combination of individuals with an interest in education…the term has been used so ubiquitously that it is in danger of losing all meaning" (p. 1). However, regardless of the size or purpose of the group, there is general agreement that PLCs incorporate five different dimensions: a) supportive and shared leadership; b) shared values and vision; c) collective and applied learning; d) supportive conditions; and e) shared personal practice (Hord, 1997; Stoll et al., 2006). With these conditions in place, members of a PLC can continuously seek, share, and act on their learning to support student achievement and growth (Hord, 1997). School improvement is made possible by increased access to peers, resources, and mentors (Bryk, Camburn, & Louis, 1999; Jones & Dexter, 2014). However, PLCs may fall short if the goals of the group are not aligned with the hopes and aspirations of team members. Moreover, minimal evidence exists linking participation on PLCs to changes in innovative behavior in the adults working on the teams.

In contrast, literature devoted to CoPs indicates a clear connection between participation on a CoP and innovative behavior and performance (Swan, Scarbrough, & Robertson, 2002). The term CoP refers to individuals who work in a common domain and share experiences and knowledge via their participation in the community (Wenger, 1998). According to Wenger, a common feature of CoPs is that membership is voluntary with groups emerging spontaneously

around interests or work activities. As Brown and Duguid (2002) explain, the spontaneity and freedom that accompanies the development and functioning of CoPs often results in organizational improvement and innovation. With this in mind, participation on the blended design thinking team at Gates was voluntary. Though the CoP structure can serve as a vehicle for improved communication, creative thinking, and collaboration, it also comes with some limitations. Jones and Dexter (2014) point out that members of a CoP may feel constrained by lack of alignment with an organization's mission, support from leadership, and time and space for meetings. Therefore, a goal of the researcher was to create a structure that maximized teacher innovative behavior by combining the benefits of PLCs (e.g., connecting the group's work to the school's vision and access to resources) with the advantages of CoPs (the focus on shared interests).

Intervention Component 3: Transformational Leadership

The third and final element of the proposed intervention was the use of transformational leadership by the design team facilitator. The theory of transformational leadership was developed by Burns (1978), who wrote of a distinction between transactional and transformational interactions between leaders and followers. In a transactional approach, the leader provides a follower with reinforcement for a service rendered with no higher purpose in mind. In contrast, the transformational leadership interaction takes place "when one or more persons engage with others in such a way that leaders and followers raise one another to higher levels of motivation and morality" (Burns, 1979, p. 382). Transformational leaders positively influence individuals, teams, groups, and organizations through the use of vision, inspiration, and motivation (Warrick, 2011).

According to Bass (1985), the transformational leader influences employees, thereby making change possible, through four behaviors: Idealized influence, inspiration, intellectual stimulation, and individual consideration. The first two components are realized by the leaders when he/she develops a vision for the future, explains how it can be reached by employees, acts as an example for others to follow, sets high standards of achievement, and shows confidence and determination (Bass, 1999). These inspirational behaviors increase employee motivation, morale, and morality. The transformational leader intellectually stimulates employees by finding ways to help them to be more creative and innovative (e.g., through professional development or access to stimulating resources) in the workplace (Bass, 1999). The final component of transformational leadership refers to the leader's efforts to coach followers with a close focus on their developmental needs (Bass, 1999).

Transformational leadership has been linked to organizational innovation in the business, organizational behavior, and education literature. Research suggests that leadership is a critical factor that influences the willingness and ability of employees to create and innovate at work (Mumford & Gustafson, 1988). According to Amabile, Conti, Coon, Lazenby, and Herron (1996) and Jung, Chow, and Wu (2003), employee creativity can be influenced directly by leadership practices (e.g., when the leader caters to a follower's needs and intrinsic motivation) and indirectly (e.g., through the establishment of a safe and supportive working climate that encourages innovation). Multiple studies have underscored the positive relationship between transformational leadership and employee creativity and innovation (Jung & Avolio, 1999; Jung, Chow & Wu, 2003; Shin & Zhao, 2003). For instance, Jung, Chow, et al. (2003) examined 32 electronics and telecommunications companies in Taiwan and detected a positive relationship between the usage of transformational leadership practices and organizational innovation. It was

also found that transformational leadership increased employee empowerment and the perception of a climate supportive of innovation. Empirical research conducted by Sarros et al. (2008) discovered that the transformational leadership dimensions of articulated vision and individual support were especially supportive of innovation.

Transformational leadership has also been examined in a school context. Kenneth Leithwood built upon the work of Burns (1978) and Bass (1985) by defining six characteristics of transformational leadership in an educational setting. Leithwood and Jantzi (2000) described how the transformational school leader articulates vision and goals, provides intellectual stimulation, models values and professional practices, possesses high performance expectations, and empowers teacher by providing opportunities for shared decision making. In their vision of the ideal transformational leader, Leithwood and Jantzi (2000) also suggested the necessity for transactional practices to ensure organizational stability (e.g., monitoring school activities and staffing). With regards to innovation, Geigsel, Sleegers, and van den Berg (1999) used qualitative methods to examine the impact of transformational leadership practices in schools characterized as high and low innovation schools (at the primary and secondary levels). The authors found that high innovation schools benefit from leaders who apply vision, individual consideration, and intellectual stimulation in their efforts to drive innovative change.

Transformational leadership and design thinking. Transformational leadership may also explain why and how design thinking increases employees' innovative and creative capacity. According to Groeger and Schweitzer (2014), transformational leadership "offers a theoretical lens through which the potential performance enhancing effects of design thinking can be explained" (p. 1). Groeger and Schweitzer argued that transformational leadership practices support the process of design thinking while also promoting a design thinking mindset across

organizations. In their thought piece, the authors first described nine key capabilities users of design thinking need to be successful (e.g., empathy towards the needs of others and willingness to embrace experimentation and testing). Next, the authors traced how each of the four dimensions of transformational leadership (idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration) directly or indirectly related to the nine design thinking capabilities. The resulting conceptual framework illustrated how transformational leadership practices inspired employees to share ideas, think critically, and develop entrepreneurial solutions to wicked problems. Schweitzer, et al. (2016) conducted empirical research to shed light on this relationship between transformational leadership and design thinking. Interviews conducted with 15 innovation managers revealed that design mindsets correspond with the four dimensions of transformational leadership.

Climate of psychological safety. Additional research suggests that transformational leadership promotes innovative behavior through two mediating variables (listed as short-term outcomes in the intervention theory of change): Psychological safety and climates of innovation. Empirical studies in the business and organizational behavior literature point out how transformational leaders are able to promote innovative behavior by creating environments that feel psychologically safe to employees. In her formative introduction to the construct, Edmondson (1999) defined psychological safety as "a shared belief held by members of a team that the team is safe for interpersonal risk taking" (p. 350). At the heart of Edmondson's (2004) model of learning is the premise that workers are afraid to engage in behaviors with uncertain outcomes due to fear of judgment from peers or supervisors. In the absence of psychological safety, employees may not engage in interpersonally risky behaviors, such as speaking up if there is a problem, asking for help when needed, reporting mistakes, or proposing new ideas

(Edmondson, 2004). In psychologically safe work climates, employees do not focus on self-protection and can participate in productive dialogue that allows for problem solving and creativity.

Several researchers have proposed links between psychological safety and creative performance in organizations. For instance, Carmeli, Sheaffer, Binyamin, & Shimoni (2014) hypothesized that psychological safety is a construct that enables creative problem solving capacity in organizations. The authors employed quantitative methods to collect data from part-time students attending two business schools in Israel. They found a direct relationship between perceptions of psychological safety and creative problem solving capacity. In a study that sought to explain how psychological safety improves innovative performance, Kark and Carmeli (2008) provided evidence that feelings of vitality play a key role. After surveying 128 part-time managers, the authors found that psychologically safe environments produce positive emotions in employees, enabling them to overcome interpersonal risks known to impede innovation on teams. These findings make sense when considered though the lenses of TICA and social cognitive theory. A psychologically safe work environment will equip employees with the confidence they need to select creative over routine action.

Climate of innovation. Transformational leadership practices were also employed by the team facilitator to create a climate of innovation. Sarros et al. (2008) define climate of innovation as the "degree of support and encouragement an organization provides its employees to take initiative and explore innovative approaches" (p. 146). Research suggests that climates of innovation create the conditions needed for actual innovation within an organization (Mumford & Gustafson, 1988). In an empirical study focused on 1,158 managers working in the Australian private sector, Sarros et al. (2008) explored the relationship between perceived transformational

leadership practices and climates of innovation. The study found that the transformational leadership factors of articulating vision and providing individual supports were positively related to climates of innovation. One again, these findings make sense when considered through the lenses of TICA and social cognitive theory. Employees will possess increased CSE and a higher threshold for productive risk taking if the environment supports innovative action.

Conclusion

Many teachers at Gates want to innovate their teaching practice but feel reluctant to do so because of the risks involved. A needs assessment conducted at Gates revealed that local contextual factors, such as a protracted contract dispute and high leadership attrition, make teachers feel vulnerable and resistant to change. Teachers also avoid innovating their practice due to relational trust concerns, change overload, a dearth of time and resources, and low self-efficacy. Using TICA and social cognitive theory as a guide, the researcher developed an intervention to address the above problem of practice. This intervention sought to increase teacher innovative behavior and involved the development of two design thinking PLCs/CoPs at Gates. Design thinking fosters risk-taking and innovative thinking through collaboration and an iterative cycle of steps. Based on the theory of change, the researcher believed that the experience of solving wicked problems on a successful design team would increase teachers' CSE, WTR, and innovative behavior. To successfully implement this intervention, transformational leadership practices were needed to encourage climates of psychological safety and innovation and opportunities for knowledge sharing. If successful, this intervention could establish design thinking as an engine of innovation, collaboration, and positive risk taking in schools. Therefore, the following chapter will provide the research design for the evaluation study at Gates that measured the success of the researcher's intervention.

Chapter 4

As the needs assessment and literature review indicated, teachers in American schools are reluctant to teach knowledge economy skills due to risks associated with the process of innovation. Chapter 3 identified teachers' low levels of creative self-efficacy (CSE) and willingness to take risks (WTR) as the two main factors associated with the problem of practice. After examining intervention literature from multiple disciplines, the researcher identified two theories that helped to inform a potential solution to this problem of practice at Gates: The theory of individual creative action (TICA) and social cognitive theory. TICA focuses on individual and contextual factors that influence one's decision to choose creative over habitual action. The action one chooses in relation to a task is determined by the combined influence of sensemaking, motivation, and knowledge/ability processes. For each of these processes, there are characteristics that increase the likelihood that an employee will select creative instead of routine action. One key characteristic explained by social cognitive theory is CSE. Teachers who believe in their ability to create and innovate will be more likely to select creative action instead of the status quo. Teachers with high levels of CSE will be more likely to persist through the myriad risks associated with the innovation.

A theory of change (see Appendix B) was developed based on TICA and social cognitive theory to provide the basis for an intervention that sought to address the problem of practice at Gates. This theory of change was used to create a logic model (see Appendix C), which illustrates key inputs, activities, outputs, and outcomes of the intervention (Cooksy, Gill, & Kelly, 2001). As the logic model indicates, Gates staff members (teachers, specialists, academic coaches, and administrators) were placed on two design thinking professional learning communities/communities of practice (PLCs/CoPs). Design thinking refers to a problem solving

approach that has been used in a variety of fields to fuel creative thinking, risk taking, and innovativeness (Brown, 2008). With support from transformational leadership, staff members used design thinking practices to conceive of and implement knowledge economy practices (e.g., technology integration or usage of the school's new maker space) in their classrooms. While increases in innovative behavior and the teaching of knowledge economy skills were the long-term outcomes listed in the logic model, the evaluation study focused on the two intermediate outcomes of CSE and WTR.

Evaluation Study and Research Questions

The following chapter focuses on an evaluation of the design thinking intervention at Gates. The evaluation measured both the fidelity of implementation of the intervention and proximal outcomes. The chapter begins with an introduction to the research design that was used to evaluate the research questions under study. Next, the methods used to recruit participants and select study instrumentation will be presented. After identifying the detailed timeline for the intervention, the chapter will delineate methods for how quantitative and qualitative data were collected and analyzed. All components of the study were aligned to the following mixed methods research questions:

RQ1: Was the design thinking intervention implemented and delivered as intended?

RQ2: To what degree did participants find the treatment to be useful?

- What do participants report as key strengths and weaknesses to the design thinking approach during the innovation process?
- What do participants report as key barriers to the design thinking process during the innovation process?

- What do participants report as factors that helped them to be successful when using the design thinking approach at Gates School?

RQ3: Were there group differences in reports of CSE and WTR from the beginning to the end of the design thinking intervention?

RQ4: Were there group differences in teachers' perceptions of climate of psychological safety, climate of innovation, and knowledge sharing from the start to finish of the design thinking intervention?

RQ5: Did teachers' perceptions of climate of psychological safety, climate of innovation, and knowledge sharing mediate the association between participation in the intervention and CSE and WTR?

Research Design

The evaluation study used a single case study design to explore the relatively new practice of design thinking in an education setting. As Martinson and O'Brien (2010) explain, case studies "can be used for several purposes, including defining the questions and hypotheses of a subsequent study, presenting a complete description of an event within its context, or establishing cause-and-effect relationships" (p. 163). The case study approach provides a method for completely and deeply understanding a program, event, or process (Yin, 2013). Martinson and O'Brien note that case studies, whether they use quantitative or qualitative methods, are especially useful for providing researchers with a rich understanding of the program implementation process. One key weakness of case designs is that they often use small samples with inadequate power to generate generalizable findings (Yin, 2013). Although it was impossible to determine causal inference from the intervention at Gates, the pilot study laid out

the groundwork for future research on the use of design thinking to promote innovation in K-12 schools.

The data collection, analysis, and interpretation portions of the study used a partially mixed concurrent equal status design. According to Leech and Onweugbuzie (2009), this typology prioritizes quantitative and qualitative strands equally and implements both simultaneously during a research process. This design is helpful when one data set is not sufficient and different questions within the same study require multiple types of data. The dissertation study included two different strands: a) a process evaluation that utilized quantitative and qualitative data to answer RQ1 and RQ2; and b) an outcome evaluation that utilized quantitative data to answer RQ3, RQ4, and RQ5. The goal of the process evaluation was to determine if the study was carried out with fidelity and to evaluate the usefulness of design thinking in a K-12 public education setting. The objective of the outcome evaluation was to measure whether the dependent variables of CSE and WTR increased for Gates staff members exposed to the design thinking intervention. This involved the collection and analysis of quantitative data pre- and post-intervention to determine relationships among the variables under study. Members of a comparison group at a second K-8 school in the district also took the pre /post tests to help the researcher better understand the intervention's impact on the treatment group. The following section examines the design features of both the process and outcome components of the study.

Process Evaluation Design

The process evaluation portion of the study was conceptualized as an efficacy study. O'Donnell (2008) explained how efficacy studies determine whether components of an intervention have been carried out and provide ongoing feedback on how the program can be

improved over time. This information is critical to determining whether fidelity of implementation has been achieved. Although multiple definitions for the term fidelity of implementation exist (Nelson, Cordray, Hulleman, Darrow, & Sommer, 2012), the broad definition offered by Holliday (2014) was used in this study. She defined fidelity of implementation as the extent to which a program or intervention is consistent with the intended program design. Dusenbury, Brannigan, Falco, and Hansen's (2003) five measures of fidelity further enrich the definition: a) adherence to the program model; b) dosage of implementation; c) quality of program delivery; d) the degree to which participants are engaged; and e) program differentiation. These measures of fidelity helped the researcher to determine if the intervention was being applied and whether the outcome measurements were a result of the intervention or of extraneous factors (Holliday, 2014).

The process evaluation was aligned with the researcher's logic model (see Appendix C). Specifically, the study was focused on activities and outputs listed on the left-hand side of the model. For instance, the process study sought to confirm that all participants in the study attended one design thinking training and engaged in the design process during meetings every two weeks. To determine fidelity of implementation, it was also critical for the researcher to determine the degree to which design team members used design strategies in the classroom between intervention sessions over the course of three months. In addition, basic quantitative data were collected to explore whether staff members perceived key activities in the treatment (e.g., transformational leadership and the presence of a PLC/CoP structure). Finally, qualitative data were collected to measure the extent to which participants found the design process to be helpful to their innovation efforts. While this qualitative data were primarily used to answer a process evaluation question (RQ2), some responses were also utilized to better understand

findings from the outcome study. The process evaluation data were critical, as programs with high fidelity across their indicators have higher internal validity, construct validity, and external validity than programs with low fidelity (Holliday, 2014; Nelson et al., 2012).

Outcome Evaluation Design

The outcome component of the study was based on a theory of treatment developed by the researcher that indicated the relationship between the proposed treatment and variables associated with the study (see Appendix D). In their seminal article on treatment theory, Leviton and Lipsey (2007) discussed the need for researchers to develop small theories that explain what happens in "the black boxes" found in many research studies. Black boxes refer to situations in which "inputs and outputs can be observed, but the connecting processes are not readily available" (Leviton & Lipsey, 2007, p. 31). Leviton and Lipsey urged researchers to develop theories of treatment based on prior literature and knowledge, to reveal these hidden mechanisms. With this in mind, the theory of treatment was developed to explain how the design thinking intervention could increase the dependent variables of CSE and WTR. The outcome component of the study focused on the measurement of constructs presented in the TOT diagram.

The theory of treatment was represented in a causal model, which posits a potential solution to the problem of practice at Gates. The two independent variables in the causality model are the treatment conditions (i.e., exposure to the design thinking intervention and the presence of a comparison group). As described above, the treatment involved exposing 11 staff members at Gates to the design thinking protocol. A comparison group of teachers and specialists/coaches from a second K-8 school in the district (the Lynch School) completed the same pre/post surveys as the intervention group, but they did not receive the design thinking intervention. The dependent variables that were measured in relation to the treatment were CSE

and WTR. The theory of treatment indicated that the intervention would increase CSE and WRT and that this increase would be mediated by the variables of psychological safety, climate of innovation, and knowledge sharing (Carmeli et al., 2013; Edmondson, 2004; Hu & Zhao, 2016; Scott & Bruce, 1994). Lines on the causal model indicate positive associations between the independent, mediating, and dependent variables. Data were collected within each intervention group before and after the treatment, and then the two groups were compared. Next, this information was compared to results collected from participants in the comparison group at Lynch School.

Methods

Participants

A purposive sampling technique was used to select participants for the evaluation study at Gates. Participation in the study was limited to Gates staff members who fell under two job designations: Classroom teacher or specialists/coaches. Classroom instructors teach mainstream academic content in self-contained classrooms (in grades K-5) or single subjects to multiple groups of students (in grades 6-8). For the evaluation study, the term specialist/coach referred to PE teachers, art teachers, music instructors, special education teachers, literacy specialists, math specialists, coaches in the Enrichment and Challenge Support Program, school librarians, and technology specialists. The study excluded part-time teachers, interns, paraprofessional aides, and student teachers working at Gates, as well as personnel not employed at Gates.

Recruitment of subjects. Potential participants who met the above criteria were invited to submit their interest in the study. The researcher initially recruited subjects at a Gates faculty meeting. At the meeting, staff members were notified of select details of the study (e.g., who could participate, the process for selection, key components of the intervention, and a method for

indicating interest). Benefits of participation, such as the opportunity to collaborate with colleagues on innovation efforts and financial incentives for participants, were also communicated. Each participant received a $600 stipend for participation in all components of the study. This funding was made possible by a local education foundation grant awarded to the researcher. The program's anticipated outcomes were not shared at the meeting or in subsequent communications, as the researcher did not want participants to behave or respond based on knowing what was expected of them. Following the staff presentation, an e-mail was sent to all eligible staff members, inviting them to submit their interest in the study. The message included details on how the evaluation study sample would be formed.

Stratified sample. A two-stage stratified sampling technique was used to form the design thinking teams. Schutt (2015) defined stratified random sampling as a "method of sampling in which sample elements are selected separately from population strata that are identified in advance by the researcher" (p. 163). In the first stage, classroom instructor teams were invited to enter a lottery, in which two teams were randomly selected out of a hat. To be eligible, at least three members of a grade level team needed to be willing to participate in the intervention. The kindergarten and first grade teams were selected in this first sampling phase (see Table 4.1 below for team composition). Once the two instructor teams were chosen, specialist/coaches who worked with students from the selected grades, and who expressed interest in the study, were randomly selected out of a hat. Through this process, the librarian and a behavior specialist were chosen to work with the kindergarten team while the technology specialist was selected to join the first grade team. This sampling approach facilitated creativity and innovation by bringing together staff members from different disciplines across the school. Forming teams based on grade levels also enabled teachers to collaborate on topics and challenges that were

developmentally relevant and appropriate to their students.

Table 4.1

Study Participants

School (and Group)	Participant Roles
Gate School	
Intervention Team 1 (*n*=5)	Kindergarten Teacher
	Kindergarten Teacher
	Kindergarten Teacher
	Behavior Specialist
	School Librarian
Intervention Team 2 (*n*=6)	Grade 1 Teacher
	Grade 1 Teacher
	Grade 1 Teacher
	Grade 1 Teacher
	Grade 1 Teacher
	Technology Specialist
Lynch School	
Comparison Group (*n* =7)	Kindergarten Teacher*
	Kindergarten Teacher*
	Behavior Specialist*
	Special Education*
	Grade 1 Teacher**
	Grade 1 Teacher**
	Technology Specialist**

*Matched to Gates Intervention Team 1**Matched to Gates Intervention Team 2

Comparison Group at Lynch School. Once the two groups were selected at Gates, a matched comparison sample of teachers was selected at a second school in the same school district (Lynch School). Lynch was specifically selected as a control site due to demographic similarities between Gates and Lynch. The researcher contacted the principal of Lynch to ask for permission to contact teachers at the same grade levels (i.e., kindergarten and first grade) and specializations (i.e., librarian, technology specialist, and behavior specialist) as the two intervention teams at Gates. After e-mailing these specific teachers, seven out of the 11 contacted

staff members agreed to participate in the study (see Table 4.1 above for team composition). Members of this comparison sample did not participate in a group or any other activities associated with the study, other than completing the same pre/post surveys as the two intervention groups at Gates.

Measures

Process Measures

The following section examines indicators that were measured to evaluate whether the proposed intervention was carried out with fidelity. Multiple indicators are described below and the collection needs and data plans for each are outlined. Information on what constitutes high fidelity and low fidelity for each indicator is also presented. According to Holliday (2014) and Nelson et al. (2012), programs with high fidelity across its indicators have higher internal validity, construct validity, and external validity than programs with low fidelity. The thresholds selected for high and low fidelity depend on a variety of factors (e.g., whether adherence, dose, quality, participant engagement, or program differentiation is being measured). The summary matrix (see Appendix E) presents the specific indicators used to measure each of the evaluation research questions, and the narrative below describes each of these indicators in detail.

Participation in one design thinking training. The first indicator that was examined in the process evaluation was staff member participation in one design thinking training. Using funds obtained from a foundation grant, the researcher hired an external consulting firm to provide the training, which exposed participants to 8 hours of content on a Saturday afternoon. In the training, the participants learned about and practiced the design thinking process under the supervision of an external expert. This critical step set the stage for use of design thinking on the two collaborative teams. The researcher used a spreadsheet to track participant attendance at the

training. High fidelity of implementation for this indicator referred to 80% of participants attending the training while low fidelity referred to less than 80% of participants attending the training.

Participation during design thinking team at bi-weekly sessions. The process evaluation also measured participant attendance at the six bi-weekly (every two weeks) design thinking meetings. As the logic model illustrates, participation in the bi-weekly meetings was a key output needed for the study outcomes to be realized. The researcher used a spreadsheet to record and track participant attendance at each of the six design team meetings. High fidelity of implementation was established at 80% participant attendance at all six sessions and low fidelity of implementation was set at less than 80% attendance.

Engagement in design thinking process during meetings. The third indicator measured in the process evaluation involved participant responsiveness to the design thinking process during bi-weekly meetings. As the researcher's theory of treatment suggested, teacher use of the design thinking process was predicted to increase the mediating and dependent variables under study. If teachers on the two design teams were not engaged in the process, it was probable that variables like CSE and WTR would not be increased by the treatment. At the conclusion of each bi-weekly session, the facilitator used a spreadsheet to capture which design thinking strategies or tools (e.g., brainstorming or prototyping) were used by participants during the meeting. High fidelity of implementation referred to 100% of participants using at least one design thinking strategy/tool at each session they attended. Low fidelity was set at less than 100% of subjects using a design thinking practice/tool at all six meetings.

Use of design tools/strategies in between sessions. Teacher participants on the two teams also applied design thinking techniques and strategies in their classrooms in between the six bi-

weekly sessions. For instance, one design team spent one session developing a strategy for making the cafeteria lunch line more accessible and less stressful for kindergarten students. After the session, team members interviewed a variety of stakeholders (e.g., students, the cafeteria monitor, and head chef), and brought data back to the next meeting for analysis. As the logic model suggests, these data-collection activities between sessions were needed for the outcomes to be achieved. The facilitator asked participants at the beginning of each session how they utilized design thinking prior to the session and captured this information on a spreadsheet. High fidelity for teacher responsiveness in this area was 80% of teachers reporting the use of design thinking in between sessions at the beginning of sessions 2 through 6. Low fidelity referred to less than 80% of participants utilizing design thinking prior to each of the sessions.

Participant awareness of transformational leadership. The process evaluation also measured whether participants were aware of transformational leadership practices used by the researcher during the bi-weekly meetings. As the logic model and theory of treatment suggest, transformational leadership is needed to increase the mediating and dependent variables under study. According to Bass (1985), transformational leaders influence employees through four behaviors: Idealized influence, inspiration, intellectual stimulation, and individual consideration. Participants on the teams were asked (via online survey provided at the end of the intervention) to identify which of the four behaviors were exhibited by the team facilitator during the intervention. High fidelity referred to 80% of participants selecting all four components of transformational leadership while low fidelity referred to less than 80% of participants choosing all four aspects.

Participant awareness of PLC/CoP elements. As mentioned before, one key element of the researcher's intervention was the presence of a PLC/CoP structure to support the work of

design team members. The PLC/CoP structure provided participants with the leadership support, physical space, time, shared values, and culture they needed to work towards the program outcomes (Brown & Duguid, 2002; Hord, 1997). At the conclusion of the three month intervention time period, participants reported on an online survey whether components of a blended PLC/CoP were available to them (e.g., access to supportive leadership and a shared space at the school) through the intervention. High fidelity for this indicator referred to 80% of participants checking off that all five components of the PLC/CoP structure were present while low fidelity referred to reports that less than 80% selected all of the components.

Perceived usefulness of intervention. The final indicator examined in the process study was the extent to which participants perceived the intervention to be useful. At the end of the intervention, each participant engaged in a 15-20 minute semi-structured interview with the researcher. Interview questions were developed to garner information on what elements of the intervention were most helpful to participants and to underscore the presence of barriers. The questions were open-ended and designed to elicit emergent themes (see Appendix F). For example, one set of questions asked: "To what extent have you benefitted from using the design thinking process over the past 3 months? What did you like about the process?" The primary goal for this data collection was to gain rich, detailed information that could be used to improve implementation of future design thinking interventions in an educational setting. A secondary goal was to utilize the qualitative data to better understand quantitative data obtained from the outcome study. High fidelity referred to 70% of the codes developed through the analysis process pertaining to perceived usefulness of the design thinking intervention.

Outcome Measures

The outcome evaluation used validated scales to measure the variables under study. The section below describes the five quantitative scales that were used to collect data pre- and post-intervention. Each scale is presented in its entirety in Appendix G. Quantitative data were collected from the treatment and comparison groups using online surveys before and after the intervention.

Creative self-efficacy. The dependent variable that was focused on in the study was CSE. As explained previously, several studies in the business and education literature have found links between CSE and creative and innovative performance in organizations (Hu & Zhao, 2016; Mathisen & Bronnick, 2009). Carmeli and Schaubroeck (2007) developed an eight-item scale by adapting a scale validated by Chen, Gully, and Eden (2001) to focus on CSE. A sample item on the scale is: "Compared to other people I can do most tasks quite creatively" (Carmeli & Schaubroeck, 2007, p. 40). To assure internal consistency, the authors administered the measure to 155 employees working in a variety of roles across two service organizations in Israel. In their study, the scale demonstrated strong reliability (α =.92).

Willingness to take risks. The second dependent variable under study, WTR, was measured using an eight-item scale developed by Dewett (2006). As explained earlier, WTR refers to the willingness of employees to take work-related risks in pursuit of positive outcomes despite the potential for negative outcomes. Each of the eight items on Dewett's scale reflects the willingness of employees to take risks despite the possibility of a negative outcome. A sample question from the scale is: "I will take a risk and try something new if I have an idea that might improve my work, regardless of how I might be evaluated" (Dewett, 2006, p. 40). In the foundational study using the WTR scale, internal consistence was α = .90.

Psychological safety. One of the key mediating variables measured in the intervention was perception of psychological safety. Edmondson (1999) defined psychological safety as a shared belief held by members of a team that the team is safe for interpersonal risk taking. Edmondson developed the scale after conducting a three-phase process at a manufacturing company. In the first phase, she developed the psychological safety scale by interviewing and observing eight teams in action. In the second phase, 53 work teams (N=496) were administered a survey, which included the psychological safety items. The final phase involved follow-up qualitative research, which examined the qualities of the top six and lowest six functioning groups. The resulting psychological safety scale included seven items rated by employees on a Likert scale. A sample question from the scale is: "It is safe to take a risk on this team" (Edmondson, 1999, p. 382). Internal consistency in the original study was α=.82 and the authors determined face/content validity through the qualitative components of the study.

Climate of innovation. A second mediating variable that was measured in the intervention study was climate of innovation. Scott and Bruce (1994) defined climate of innovation as the degree to which individuals perceive dimensions of an organization's climate as supportive of innovation. The authors developed their scale by modifying and extending a measure created by Siegal and Kaemmerer (1978). The authors selected 16 items from the original scale (8 from a support for creativity subscale and 8 from a tolerance for difference subscale). They also wrote four additional items to assess perceived access to the resources needed for innovation. A sample question from the *support for creativity* subscale is: "Our ability to function creatively is respected by the leadership" (Scott & Bruce, 1994, p. 593). An item developed for the *access to resources* subscale is: "There are adequate resources devoted to innovation in this organization" (Scott & Bruce, 1994, p. 593). In the Scott and Bruce study, the

reliability for support for creativity was α=.92 and resource supply was α=.77. Siegal and Kaemmerer assured face/content validity for the original questions through two pilot studies conducted in multiple schools with teachers and students. The researcher adapted questions from both subscales to apply to teachers working in a K-12 educational setting.

Knowledge sharing. The third mediating variable measured in the study was knowledge sharing. Knowledge sharing refers to "the process through which employees exchange knowledge and experiences to derive new ideas and create knowledge" (Hu & Zhao, 2016). To measure the knowledge sharing behavior of design thinking team members, items were used from a seven-item scale developed by Chennamaneni (2006). The measure seeks to determine how frequently employees share knowledge with colleagues. A sample question from the scale is: "I shared factual knowledge (know-what) from work with my co-workers" (Chennamaneni, 2006, p. 42). Internal consistency for this scale was α=.928. The researcher selected four of the seven items to be used in the study.

Procedure

The following section examines the components of the intervention and procedures that were used to collect and analyze data. Over the course of three months, participants on the design thinking teams received training on the design thinking process, met bi-weekly (twice per month) to carry out various facets of the design thinking process, and applied strategies and goals used in the meetings to innovate in their classrooms. Qualitative and quantitative data were strategically collected before, during, and after the intervention to evaluate program fidelity and outcomes. Pre/post data were also collected from staff members at the comparison site, the Lynch School. Table 4.2 presents a timeline for when key intervention and data collection/analysis activities took place.

Table 4.2

Intervention Timeline

Intervention Activity	Participants	Timeline
Recruitment presentation at Gates whole staff meeting; comparison group recruited at Lynch	All Gates staff members Specific members of Lynch staff invited to participate	October 2017
E-mail sent to Gates staff members eligible for intervention to seek participants	Gates staff members eligible for participation in study	October 2017
Members of the design teams were selected and notified	Gates staff members eligible for participation in study	October 2017
Design team members and Lynch comparison group completed online consent forms and pre-test surveys	Members of the two design thinking teams at Gates and Lynch comparison group	October 2017
One full-day training session on the design thinking process	Members of the two design thinking teams and external facilitator	November 2017
Bi-weekly design thinking meetings after school (the teams met on different days of the week)	Members of the design thinking teams	Mid-November 2017 until the end of January 2018 (6 total sessions)
Participants applied design thinking strategies in their classrooms between the bi-weekly sessions	Members of the design thinking teams	Mid-November 2017 until end of January 2018
Post-test survey and semi-structured interviews were conducted for intervention team; post-test survey was conducted for comparison group	Members of the design thinking teams and comparison group	February 2018

Intervention Components

Chapter 3 identified the elements of the design thinking intervention: Blended PLCs/CoPs to provide structure and purpose, the use of design thinking on the teams, and the presence of transformational leadership. The following section identifies and explains the key activities that took place throughout the three-month intervention, which included: a) the initial training; b) bi-weekly design meetings; and c) application of design strategies between sessions. The recruitment, data collection, and data analysis activities listed in the Evaluation Summary (Appendix E) are described in other sections of the chapter.

Training. After participants were selected for the study, a one-day training was offered to team members on November 4, 2017. A consultant was brought to Gates to teach the design thinking process and mindset to members of both intervention teams. This training exposed design team members to the core elements of design thinking, including the development of empathy, defining needs, ideation, prototyping, and implementation. Design team members developed specific tools (e.g., interviewing with empathy and group brainstorming) and gained familiarity with the design thinking process through hands-on activities. For instance, group members were split into pairs and provided with the goal of constructing the ideal wallet for their partners. This task required them to interview a partner, develop an understanding of the partner's problem (i.e., he/she does not possess the ideal wallet), brainstorm ideas for a better product, prototype a new wallet using supplies, get feedback from the partner on the prototype, and make changes to the wallet until the partner was satisfied. The ultimate goal of the training was for group members to develop the skills and mindsets needed to successfully use design thinking in an educational context. See Appendix H for additional details on training and sessions.

Bi-weekly design thinking team meetings. Each of the design teams met separately twice per month (for a total of six meetings) to use design thinking to promote the teaching of knowledge economy skills at Gates. The bi-weekly meetings took place at Gates after school for two hours per session. The team facilitator used transformational leadership practices to guide the teams as they strived to innovate in the blended PLCs/CoPs. The purpose of the first three sessions was to give participants an opportunity to apply design thinking to resolve relatively small problems. Some of the initial sessions focused on identifying school-wide challenges. For instance, the first grade team decided to design-think a solution to a particularly vexing transition from recess back into the school for first grade students. After selecting this focus, the group brainstormed users to be interviewed and questions that might elicit information that could be used to develop a prototype at a future meeting. A subsequent session involved the sharing of user information obtained from interviews and the selection of one or more potential solutions to the problem.

In the final three sessions, the intervention teams were empowered to use the design thinking process to connect some aspect of their teaching to the school's new maker space. Sheridan et al. (2014) define maker spaces as "informal sites for creative production in art, science, and engineering where people of all ages blend digital and physical technologies to explore ideas, learn technical skills, and create new products" (p. 505). Research suggests that teachers can include maker spaces in their efforts to teach knowledge economy skills required by modern employers. Specifically, anecdotal and empirical evidence reveals that maker spaces promote technology use (Sheridan et al., 2014), peer collaboration (Papavlasopoulou, Giannakos, & Jaccheri, 2017), creative problem solving (Moorefield-Lang, 2015), and student risk taking (Oliver, 2016).

With support from the facilitator, the two intervention teams planned instructional activities that connected students to the new maker space. The kindergarten team chose to integrate the maker space into an existing engineering unit on structures. Specifically, they developed a final assessment for the unit that required students to apply lessons learned to the prototyping of new architectural designs for passageways between the kindergarten and main building at Gates. Students had the opportunity to interview a variety of stakeholders (e.g., architects and teachers), build multiple prototypes, receive feedback from adults and fellow students, and present their final projects. The first grade team developed a new project that involved students imagining and constructing the ideal lunch box for a peer. After being put in teams of two, the partners interviewed one another for empathy, built prototypes for lunchboxes based on this information, received feedback on the initial designs, built new lunchboxes, and presented their final lunch boxes at the conclusion of the project. For both teams, the development and use of the maker space was especially challenging at Gates because the school has an open design with no walls between classrooms. Innovative thinking in a supportive setting was needed to overcome the "wicked," ill-defined problems that emerged as teachers sought to successfully integrate maker space learning in this unique architectural space.

Use of design strategies between sessions. It was critical for design team members to use design-thinking techniques in between the bi-weekly meetings. For instance, during the kindergarten maker space activity, team members used time between sessions to plan, implement, and fine-tune many aspects of their new maker space assessment. When issues emerged (e.g., managing materials in an open space with so many young students), participants exchanged ideas with teammates and made adjustments. They then brought this information to the next session for further discussion, collaborative brainstorming, and prototyping. The first

grade team also used time between sessions to develop, carry out, and tweak their maker space project. For example, in between sessions 5 and 6, two of the teachers noticed that students were struggling to give feedback on one another's lunch boxes. The teachers discussed this issue in their classrooms, brainstormed adjustments, tried out the new ideas, and brought stories of success and failure to the next meeting, where they could use design thinking to brainstorm new and improved solutions.

Data Collection

Quantitative and qualitative data were collected during the process and outcome components of the study to answer the research questions. As explained above, a partially mixed concurrent equal status design was used in the data collection, analysis, and interpretation phases of the study. Using this model, the researcher collected and analyzed quantitative and qualitative data separately before mixing them in the interpretation phase of the project. Data were collected via several different formats explained below and in Appendix E.

Process evaluation. The process evaluation measured the degree to which components of the study were carried out with fidelity, and whether Gates staff members were responsive to design thinking. A combination of quantitative and qualitative data was collected to measure the indicators included in the process evaluation (see Appendix E). Attendance data were collected by the team facilitator/researcher on a spreadsheet to track attendance at the training and six bi-weekly sessions. To determine the extent to which faculty members were engaging the design thinking process during the sessions, the facilitator/researcher recorded what design thinking strategies, steps (e.g., prototyping), or tools had been used by participants at each of the six meetings. Information regarding which design thinking strategies were utilized by participants in between sessions was recorded at the beginning of sessions 2-6. An online self-report form was

used by participants at the end of the intervention to indicate the presence of transformational leadership practices (i.e., idealized influence, inspiration, intellectual stimulation, and individual consideration) used by the facilitator during the intervention. Participants also checked off which elements of a blended PLC/CoP structure were available to the team (e.g., space at the school for the sessions and the availability of resources) on the post survey.

Qualitative data were collected via semi-structured interviews at the end of the intervention to answer RQ2, which focused on the degree to which participants found the intervention to be useful. The researcher took detailed notes on his laptop during each interview and used member checking to ensure the trustworthiness of the data. According to Nastasi and Schensul (2005), member checking refers to "procedures for confirming the veracity of data and interpretations with representatives of the target population" (p. 185). After each question, the author gave participants the opportunity to verify, disagree with, or augment their responses.

Outcome evaluation. The outcome evaluation strand of the study utilized a pre-test-post-test design with a comparison group. For each of the two design teams, pre- and post-intervention quantitative data were collected for the three mediating variables (knowledge sharing, climate of psychological safety, and climate of innovation) and the two dependent variables (CSE and WTR). The surveys were completed and delivered through the Qualtrics platform. The researcher exported all responses for the pre- and post-tests into SPSS for analysis. The same pre- and post-test surveys were provided to the Lynch School comparison group in an effort to help the researcher better understand the effects of the intervention. These data were also exported from Qualtrics to SPSS for analysis.

Data management. To ensure participant confidentiality, the researcher assigned a unique ID for each participant for use on surveys and interview notes. A crosswalk that linked

participants to their IDs was stored in a password-protected file. Data generated by the online surveys was secured in a password protected Qualtrics account. All other data collected by the student investigator during the initial training, six design thinking sessions, process evaluation surveys, and qualitative interviews were secured on a password-protected computer. Moreover, any paper-based data or records generated were stored and maintained in a locked file cabinet in the researcher's office. These data will be stored for a minimum of three years following the publication of the results. When the three-year limit has passed, all files will be securely deleted from the computers and password protected account.

Data Analysis

Using the partially mixed concurrent equal status design approach, the researcher analyzed quantitative and qualitative data separately before mixing the data during the interpretation phase. Data collected for the process evaluation were analyzed throughout the study while data collected via the outcome evaluation followed a pre-post collection and analysis schedule. The following section details techniques that were used to analyze quantitative and qualitative data collected from the process and outcome evaluations.

Quantitative data. Quantitative data analysis enabled the researcher to establish fidelity of implementation and examine changes to mediating and dependent variables from pre- to post-intervention. Basic online tracking mechanisms, such as self-report forms and attendance tracking spreadsheets, were used by the researcher to measure program fidelity (in the areas of adherence, dosage, and participant responsiveness). The researcher viewed this information as it was presented on Excel spreadsheets and made adjustments when needed to the intervention (e.g., if one or more participant was not attending the bi-weekly design thinking sessions).

In the outcome study, the researcher used SPSS to find the reliability (internal consistency) of scales and the kurtosis and skewness of the distributions. Basic descriptive statistics (the mean, median, and standard deviation) were analyzed to examine changes to the variables from pre to post within the two intervention teams at Gates and the comparison group at Lynch. Next, the researcher examined the equivalence at baseline of the treatment and control groups by measuring the difference between the groups on each variable at pre-test. According to the Institute of Education Science (2014), this practice is critical because differences across groups at baseline on key characteristics can influence study outcomes (i.e., a discovered effect could be the result of pre-existing differences). One-way ANOVAs were utilized to test the mean differences between the groups at baseline. Next, multiple regressions analysis was conducted to estimate the association between teacher's post-test scores (the dependent variable) based on their group (the independent variable) and pre-test scores (which were grand mean-centered). As Pedhazur (1982) explains, multiple regression is most useful when one wants to predict the value of a variable based on the value of two or more variables. Given the study's small sample size and the non-normal distribution of some of the data, the researcher also chose to apply a nonparametric test, the Mann-Whitney U Test. Vogt (2006) explains that nonparametric techniques can be especially powerful when outcomes are not normally distributed.

Qualitative data. Qualitative data were collected via the process evaluation in the form of responses to interview questions related to the design thinking process (for Q2). As previously mentioned, the qualitative data also played a key role explaining some findings from the outcome study, as some of the emergent themes shed light on questions Q3, Q4, and Q5. The researcher applied Braun and Clarke's (2006) thematic analysis approach to identify and analyze patterns within the interview data. According to Braun and Clarke, the researcher plays an active

role in a recursive process that involves "a constant back and forward between the entire data set, the coded extracts of data, and the analysis of the data you are producing" (p. 15). Using this approach, the researcher familiarized himself with the data by reading the interviews several times, taking notes in the margins, and recording initial impressions in a reflexive journal. Next, the responses were broken down into chunks and coded. A code book was created in a separate file to track and record codes as they were revised and augmented throughout the analysis process (Saldana, 2009). The codes were examined multiple times and emergent themes were generated for each group. After themes had been determined for the two teams, the researcher compared and contrasted key similarities and differences across the groups. During the interpretation phase, the researcher connected some of these themes to quantitative data collected in the outcome analysis in an effort to connect the findings to theory and practice. The researcher used a reflexive journal to record these findings and track how potential biases potentially shaped data interpretation.

Delimitations

While the Chapter 5 discussion will examine limitations that impacted study findings, it is also important to consider the study's delimitations. O'Leary (2014) defines the term delimitation as a study's boundaries or how the study "was deliberately narrowed by conscious exclusions or inclusions…" (p. 76). One of the most important delimitations was the researcher's choice to conduct a single case study rather than focus on the experiences of teachers working in several schools sites inside or outside the district. This conscious decision was based on the exploratory nature of the research and a desire to advance the literature on design thinking by deeply focusing on one school site. Similarly, the choice to focus on 11 staff members at Gates (and seven members in the comparison group) reflected the researcher's interest in gaining a

deep and rich understanding of the intervention, even if it was at the expense of the study's generalizability. Finally, a mixed methods design was selected to harness the strengths of both quantitative and qualitative methodologies in order to shed light on a topic that has received minimal attention in the education literature.

Conclusion

This chapter outlined the design for an evaluation study that measured the fidelity and outcomes associated with an intervention conducted at Gates School. Using a single case study methodology and a partially mixed concurrent equal status design approach, the researcher studied the role of design thinking in promoting innovative behavior. A process evaluation measured the degree to which the intervention was carried out as illustrated in the intervention logic model (see Appendix C). Qualitative data were also collected from participants to deeply explore the extent to which they found the experience of being on a design team to be helpful. The outcome evaluation, which was based on a theory of treatment (Appendix D), measured the extent to which the two intervention groups responded to the design thinking treatment relative to a comparison group. Quantitative data were collected from both groups pre- and post-intervention to determine group differences in the dependent and mediating variables under study. Data were collected and analyzed separately and then mixed during the interpretation phase of the study to harness the strengths of both quantitative and qualitative approaches. Chapter 5 will share the results of the study, interpret the findings using theory, and explore implications for future research and practice.

Chapter 5

The purpose of this chapter is to discuss findings from the design thinking intervention study carried out at Gates School. As Chapter 4 explained, the intervention took place between November 2017 and January 2018, and focused on the experience of 11 staff members who used design thinking to develop new school routines and instructional innovations. Using a partially mixed concurrent equal status design approach, quantitative and qualitative data were collected to determine the degree to which exposure to three treatment elements (design thinking, support from a transformational leader, and participation on a professional learning community/community of practice [PLC/CoP]) increased teachers' creative self-efficacy (CSE) and willingness to take risks (WTR). Data were collected from a comparison group at a sister-school in the district to help determine potential effects of the intervention. A process evaluation was simultaneously carried out to measure fidelity of implementation and participant experiences on the design teams.

The sections that follow will be organized around the research questions that framed the evaluation study. The first part will analyze quantitative and qualitative data that were collected to answer the two process evaluation questions (RQ1 and RQ2). In the next section, quantitative data from the outcome evaluation will be explored to provide a better understanding of RQ3, RQ4, and RQ5. The focus will then turn to interpreting these data based on theory, past research, and the mixing of quantitative and qualitative data from the study. A limitations section will underscore challenges that emerged during the study that may impact findings. Lastly, implications for research and practice will be examined.

Process Evaluation

The purpose of the process evaluation was to determine whether core components of the intervention were carried out as the researcher intended (Holliday, 2014). This information was critical to the researcher, as programs with high fidelity are known to have higher internal, external, and construct validity than programs without these factors (Nelson et al., 2012). The following section analyzes quantitative and qualitative data that were collected in the effort to answer the two questions below:

RQ1: Was the design thinking intervention implemented and delivered as intended?

RQ2: To what degree did participants find the treatment to be useful?

- What did participants report as key strengths and weaknesses to the design thinking approach during the innovation process?
- What did participants report as key barriers to the design thinking process during the innovation process?
- What did participants report as factors that helped them to be successful when using the design thinking approach at Gates School?

Fidelity of Implementation (RQ1)

As explained in Chapter 4, several indicators were measured to evaluate the extent to which the intervention was delivered and implemented as intended. Data were collected for each indicator using the techniques outlined in the summary matrix (see Appendix E). Data were then analyzed to determine if the indicators met the criteria for high or low fidelity. The results of this analysis for each indicator are presented and described below.

Participation in one design thinking training and the bi-weekly sessions. The first two indicators measured in the study sought to measure participant attendance at the initial

training and the six bi-weekly sessions. Using an Excel spreadsheet, the researcher documented participant attendance at the beginning of each meeting. High fidelity of implementation was set at 80% of participants attending the training (low fidelity was established at less than 80% attendance). At the training, 7/11 (64%) of the study subjects participated (see Table 5.1). The training was held on a Saturday and the four participants who could not attend had pre-existing plans on that day. Since the training was a key component of the intervention, key ideas and skills were repeated at Session 1 (which had 100% attendance) to ensure that all participants understood the design thinking process. A second related indicator involved participant attendance at the six sessions. High fidelity was set at 80% of participants attending all six meetings and low fidelity was established at less than 80%. For this indicator, high fidelity was reached as 9/11 (82%) of the subjects attended all of the sessions.

Table 5.1

Attendance at Training and Sessions, N =11

Training/Session	Attendance *n* (%)
Training	7 (64)
Session 1	11 (100)
Session 2	11 (100)
Session 3	11 (100)
Session 4	10 (90)
Session 5	10 (90)
Session 6	11 (100)

Engagement in design thinking process during meetings. The process evaluation also measured participant responsiveness to the design thinking process during the six sessions. At

the end of each session, the researcher used a spreadsheet to write down which design thinking tools/strategies were used and whether each participant used the tools/practices (see Appendix H for session descriptions). Given the centrality of design thinking to the intervention process and the small number of participants in each group, the threshold for fidelity was set at an especially high level. High fidelity of implementation was set at 100% of subjects using at least one design thinking strategy or tool at each session they attended. Low fidelity referred to less than 100% of participants utilizing the design process at all six meetings. The high fidelity threshold was reached for this indicator as 100% of the members on each of the two teams used design thinking tools and strategies at each session (see Table 5.2).

Table 5.2

Engagement in Design Thinking Process At and In Between Sessions, N=11

Session	In session *n* (%)	Between each session *n* (%).
1	11 (100)	n/a
2	11 (100)	9 (82)
3	11 (100)	9 (82)
4[a]	10 (100)	10 (100)
5[a]	10 (100)	10 (100)
6	11 (100)	11 (100)

[a]1 participant did not attend the session.

Use of design tools/strategies in between sessions. A fourth key indicator measured in the process evaluation was participant use of design thinking in between sessions. After each meeting, participants agreed to use some aspect of design thinking in their classroom or another part of the school. They would then bring information related to this "homework" back to the group and share what they had gathered or learned. To measure this indicator, the facilitator

started sessions 2 through 6 by asking participants to share what they had accomplished/learned between meetings. The researcher used a spreadsheet to record which teachers had accomplished this work. High fidelity for teacher responsiveness in this area was set at 80 percent of teachers reporting use of design thinking in between sessions 2 through 6 (low fidelity was set at less than 80%). High fidelity was reached for this indicator, as more than 82% of subjects reported using design thinking in between sessions at sessions 2 through 6 (see Table 5.2 above for results).

Participant awareness of transformational leadership and PLC/CoP structure. In the online evaluation post study, subjects were asked to identify which characteristics of transformational leadership and the PLC/CoP structure were present during the intervention. The transformational leadership question required respondents to check off which of the four characteristics of transformational leadership (idealized influence, inspiration, intellectual stimulation, and individual consideration) were observable in the facilitator's leadership style. High fidelity was established at 80% of participants selecting all four components while low fidelity was set at less than 80%. As Table 5.3, below, indicates, high fidelity was reached with 90.9% of subjects selecting all four transformational leadership characteristics. A second question on the post survey measured participant awareness of the five elements of a PLC/CoP throughout the intervention (i.e., a common vision for the group, access to a space in the school, support from a facilitator, resources, and the opportunity to volunteer for the study). High fidelity was set at 80% of subjects checking off that all five components were present (low fidelity was set at less than 80%). As Table 5.3 indicates, 100% of subjects across both of the intervention groups reported all five components of a PLC/CoP were present during the intervention.

Table 5.3

Participant Awareness of Transformational Leadership and PLC/CoP Structure

	Identification of all 4 characteristics of TL *n* (%)	Identification of all 5 characteristics of PLC/CoP structure *n* (%)
Group 1 (*N*=5)	5 (100)	5 (100)
Group 2 (*N*=6)	5 (83.3)	6 (100)
Total Group Score *(N*=11)	10 (90.9)	11 (100)

Usefulness of the Treatment (RQ2)

The second process evaluation question (RQ2) explored the extent to which participants on the design PLCs/CoPs found the intervention to be useful. In this qualitative portion of the study, each participant was interviewed for 15-20 minutes and asked about: a) what they liked about the design thinking process; b) challenges that emerged when using it; c) factors that supported them throughout the intervention to be successful; and d) how the process might be successfully applied in a K-12 public education setting (see Appendix F for specific questions). After identifying 60 codes from the interviews, the researcher organized the results into several overarching themes. High fidelity for this indicator was established at 70% of the codes relating in some way to perceived usefulness of the intervention (low fidelity was set at less than 70%). An analysis of the codes revealed that high fidelity was met, as 80% of the codes were related to the usefulness of the practice. After reviewing the data and codes several times, the researcher identified the themes below.

Innovating through empathy. Some of the emergent themes related to design thinking steps participants perceived to be especially helpful to their efforts to create and innovate.

Participants in the intervention felt that the first step of design thinking—to empathize when gathering data —was especially critical to the innovation process. As previously explained, this stage involves the use of active listening and empathy to understand the perspectives of others and more accurately diagnose the problems they were addressing. Intervention participants used an interviewing-with-empathy approach to develop an authentic understanding of peers' motivations, emotions, and thoughts. For example, participants on the kindergarten team used the approach to gain critical information that helped to diagnose wicked problems peers were experiencing during the implementation of the engineering maker space assessment. With this knowledge, they were positioned to conceive of and develop more useful and innovative solutions to the problems they were engaging. Participants suggested that this approach helped them to create more innovative solutions on the design thinking teams. For instance, one teacher shared, "Listening is a hard skill for me in general because I am always thinking about my ideas or next response…this stops me from hearing what others are doing and responding in a meaningful way. It's nice to get people to slow down and see what everyone needs before trying to solve their problems in an innovative way" (J. McGrath, personal communication, January 30, 2018). A second teacher concurred and said, "We often try to listen and think at the same time…interviewing for empathy helps us to actually hear what others are saying and identify a real problem in their lives" (T. Reddy, personal communication, January 29, 2018).

Initial activities that encouraged the use of empathy also helped participants to build camaraderie with colleagues on their design teams. One teacher said, "My favorite part was getting to know my colleagues better…the empathy piece was big" (K. Richy, personal communication, February 7, 2018). Multiple participants shared how they rarely have opportunities to truly listen to one another during the school year and how the empathy step of

design thinking helped them to better understand their peers. As one participant explained, “It’s so nice to go outside the normal routine and really get to know someone…I learned about a colleague’s challenges during the morning routine activity and felt like I really came to know her” (E. Johnson, personal communication, February 6, 2018). Three teachers expanded on this idea by suggesting how the interviewing for empathy technique can be used in the future to foster cohesiveness across the faculty at Gates. As one teacher explained, “More empathy across the school would help the school’s community… .We don’t know what others are doing across the building and could solve each other’s problems through these valuable practices” (M. Leger, personal communication, January 30, 2018).

Brainstorming/ideation and innovation. The third step of design thinking—to brainstorm/ideate—was also identified as a powerful driver of risk taking and innovation. As explained in Chapter 4, intervention participants used a variety of brainstorming tools to derive solutions to problems discovered through the first and second steps, empathize and define problem. For instance, during the lunch box maker space activity, teachers paired off and interviewed one another about problems they were experiencing when introducing first grade students to the Gates maker space. Once each teacher had identified and verified a problem for his/her partner, the next step was to write/draw out five different solutions, even if the ideas were outlandish. These solutions were then shared with the larger group for feedback and other potential solutions. Participants discussed how such strategies helped them to discover creative and innovative solutions to the problems under study. One teacher shared, “The part that pushed me the most was the ideating part…brainstorming forced multiple solutions. It got easier each time I did it, and I was much more willing to come up with crazy ideas even if they weren’t possible” (T. Reddy, personal communication, January 29, 2018). Another teacher concurred,

saying, “It forced us out of our own thoughts by forcing us to really consider all the possibilities” (B. Thomas, personal communication, February 5, 2018). This experience of generating new ideas in a collaborative environment increased teachers’ creative confidence over time. One teacher explained, “I felt nervous the first time I had to brainstorm so many solutions to a problem but got more confident over time. After that first time, I realized I could easily come up with more than one solution, some of them really good. It helps to know that it’s in there inside you” (A. Carol, personal communication, January 30, 2018). After moving past the initial awkwardness of the process, teachers found the brainstorming/ideation phase to be fun, stimulating, and beneficial.

Iteration and risk taking. Another common theme was teachers’ deep appreciation for the opportunity to iterate when using the design thinking protocol. As explained in Chapter 3, iteration refers to the frequent need to go back to the beginning of a step, or the entire design thinking process, after receiving feedback on an idea or product (Brown, 2008). Design thinking is cyclical in nature and it takes time, patience, a willingness to accept feedback, and often several prototypes to develop something truly innovative. Through the intervention at Gates, participants often needed to cycle back to previous design thinking steps to address concerns raised during the prototype and try it phases. Study participants revealed that this iterative approach promoted innovation by reducing fear of failure. One first grade teacher explained, “The iteration part…you try and do it again and again…was a really good model for those who worry about failing…. the process accepts failure, as you are creating something better and watching it happen” (K. Elmore, personal communication, January 29, 2018). Another teacher pointed out how design thinking helped her to deal with her own struggles to be perfect all the time. She shared, “For years I have been taught that I must be perfect on the first try. Design

thinking frees me from this negative way of thinking" (E. Johnson, personal communication, February 6, 2018). A third teacher concurred and shared that the experience of using an iterative approach to problem solving positively influenced her teaching and life outside of school. She said, "To be honest, I didn't like the iteration part at first. The value of it was that it pushed you to come up with new ideas and be risky…it was ok to be wrong because I was going to do it again…this is something I am now applying when I make lessons and even to outside life" (M. Leger, personal communication, January 30, 2018). In all of these cases, the freedom to fail during a process of continuous improvement opened the door to risk taking and innovation.

A remedy for *solutionitis*. As participants reflected on the intervention as a whole, they discussed how the various design thinking steps helped them to avoid what Bryk, Gomez, Grunow, and LeMahieu (2015) have coined as *solutionitis*. One teacher, who identified herself as being risk averse, shared, "I have been trained to come up with the right answer whenever someone asks me a question or demands that I solve a problem. The empathy part of design thinking forced me to hear what people were saying without imposing my own bias, and the brainstorming activities helped be to avoid *solutionitis*" (E. Johnson, personal communication, February 6, 2018). Multiple teachers discussed the impact of *solutionitis* on innovation. As a kindergarten teacher shared, "I am supposed to get the right answer right away…so I jump to the first solution that comes to mind even though it may not be the best informed or creative idea" (E. Lilly, personal communication, February 5, 2018). Design thinking practices forced teachers out of this habit by encouraging active listening, the brainstorming of several ideas before solution selection, and iteration, which empowered them to learn from failure.

Importance of trusting relationships. As predicted by the literature on relational trust in schools (e.g., Bryk and Schneider, 2002), one factor that made the design thinking process

successful was the presence of trusting relationships. Eleven of 11 participants (100%) shared that trusting relationships with peers reduced the risks associated with innovation in a group environment. One kindergarten teacher explained, "It was great to be with people you knew…I felt like I could say anything" (B. Thomas, personal communication, February 5, 2018). A second teacher elaborated by stating, "When you take risks, there has to be trust in people. I am risk averse in general, so I need to be around people who I believe are encouraging me" (K. Richy, personal communication, February 7, 2018). Three of the participants explained how trust in colleagues created a sense of comfort that opened the door to experimentation, failure, and creativity. Much of this comfort came from prior, positive work with one another. According to one first grade teacher, "This group felt like a low risk environment because we have always been a supportive team and group anyways…we have all taken risks to be vulnerable with each other in the past" (E. Johnson, personal communication, February 6, 2018). This feeling of comfort even allowed teammates to comfortably disagree with one another when defining problems, brainstorming, and prototyping.

The importance of diverse thinking on teams. While trust based on past experience and comfort was cited as a key to risk reduction, the presence of diverse thinking on teams was also identified as a driver of innovation. Four of 11 (36%) of participants discussed the positive influence of diverse perspectives on group creativity and innovation. According to one teacher: "We had diversity in our group, which allowed me to ask questions and learn from expertise…by having mainstream teachers and specialists on our team, we were able to come up with more innovative ideas than if the team didn't have those differences" (K. Elmore, personal communication, January 29, 2018). As predicted by the literature, the availability of different perspectives was especially helpful during the third step of the design thinking process: Ideation

and brainstorming (Hu & Zhao, 2016; Seidel & Fixson, 2013). One specialist shared, "When we were brainstorming solutions to the problems, we got to see so many different ideas because of the diversity of the group, which really got me going" (V. Blue, personal communication, February 6, 2018). The experience of working closely with colleagues from other specialties caused two participants to speculate that design thinking would be most effective when used by heterogeneous teams.

Supportive leadership. Intervention members also pointed out the relationship between supportive leadership and their willingness to engage in design thinking activities that required risk taking. The data indicated that seven out of 11 (64%) participants perceived leadership to be a key determinant of success during the intervention. One member recognized the ability of the session facilitator to create a "clear vision of what was being done and modeling each of the steps so we could be successful" (A. Carol, personal communication, January 30, 2018). Others pointed out how characteristics of the facilitator's approach made the design thinking process feel less scary and intimidating. For instance, one subject said, "He told us, 'You are going to try something new out of your comfort zones,' which made me feel like I could take risks and do things unexpected without knowing what end results would be. The risks weren't scary" (B. Thomas, personal communication, February 5, 2018). A fellow colleague concurred, saying, "He told us anything was possible and pushed us, which made me get even more innovative. I moved on from the quick fixes to more innovative, risky ideas" (K. Richy, personal communication, February 7, 2018). Teachers felt less constrained when leadership provided them with the tools, support, vision, and freedom to think creatively.

When sharing these positive experiences with the intervention leader, three of 11 (27%) staff members discussed a leadership style that would not be compatible with design thinking:

Top down leadership. These participants suggested that they would avoid design thinking in their work if they were told they had to implement it as practice. One teacher explained, "Something I liked was the piece around volunteering for it…if you are interested, you can learn to solve problems using this method. If I was told I had to implement it, I would not really do it and just pretend" (E. Johnson, personal communication, February 6, 2018). A second team member discussed the "beauty of the democratic process we used to solve problems. This is a better way of going than top down, as we would not be invested in it" (E. Lilly, personal communication, February 5, 2018). Thus, the leader was recognized for providing the right amount of support but also distributing leadership and agency across the teams.

When asked to discuss how design thinking might be useful in a K-12 public school, multiple staff members pointed out the need for permission from school leadership to use the practice. Specifically, school leaders need to provide teachers with the time, resources, and permission to use design thinking on teams or as an instructional strategy. One teacher suggested, "Design thinking has potential for greater freedom, solutions to problems, and a better education for kids. But administration needs to buy into it and tell us it's ok to do it" (J. McGrath, personal communication, January 30, 2018). Staff members shared that permission could be shared not just verbally but also through specific actions, such as putting aside time in the schedule for teachers to use the practice. One teacher explained, "We would need time to veer off of our set activities and curriculum to do it…leaders must prioritize this as much or more than other things for it to happen" (J. Fisher, personal communication, January 31, 2018). Teachers will be more likely to take the risks associated with design thinking if they are given a clear green light from leadership.

Time and energy. As participants reflected on their experiences, time and energy were repeatedly discussed as key barriers to the intervention's success. Some of the participants focused on the challenge of adding 20 hours of meetings to their already busy schedules. As one participant explained, "My schedule made it hard to come to the group every time…it was just tough to work it into an already full day" (B. Thomas, personal communication, February 5, 2018). Others spoke about the challenges of bringing (and maintaining) energy to the two-hour after school sessions. The specific timing of the program during the holiday season was also cited as an impediment to implementation. One teacher shared, "Time and energy were huge issues as the holiday months of November and December are particularly rough" (K. Richy, personal communication, February 7, 2018). Two teachers suggested that design thinking sessions would be most effective during the summer months, when teachers are refreshed and in a more innovative space. As a potential remedy to these timing issues, it was suggested that design thinking could be combined with existing responsibilities during the school day to ensure that it does not become another time-consuming responsibility.

Imbalance in responsibilities between classroom teachers and specialists. Multiple participants on the intervention teams noticed minor challenges that arose due to the inclusion of specialists on each of the design teams. On the one hand, the heterogeneous nature of the groups promoted valuable knowledge sharing during the ideation/brainstorming phase of design thinking. However, some classroom teachers felt that some of the intervention tasks required them to do more work in between and during the sessions than the specialists. As one teacher explained, "I love the specialists who work with us…they are amazing, but they weren't as involved in the work we were doing, which felt a bit unfair" (T. Reddy, personal communication, January 29, 2018). One specialist agreed with this assessment, sharing, "I felt really bad that I

wasn't contributing as much as the teachers to the projects…I didn't always feel helpful" (J. Fisher, personal communication, January 31, 2018). This perception of imbalance may have been exacerbated by attendance trends, as specialists were disproportionately absent from the training and sessions (the three specialists accounted for 83.3% of total absences).

Design thinking for whole school improvement. Lastly, participants underscored the usefulness of design thinking by sharing how the practice can be applied to stimulate innovation in K-12 schools. Seven of 11 (64%) participants suggested that design thinking could be a useful practice on a variety of school-wide PLCs/CoPs in the future. For example, multiple teachers thought the process could be especially helpful to the process of building and maintaining a master schedule at Gates. As one teacher explained, "Setting up a K-8 master schedule is really hard, and you need so much trial and error…design thinking would be perfect for this" (K. Elmore, personal communication, January 29, 2018). Other teachers argued that design thinking could be used as a problem solving strategy when making the cafeteria feel less chaotic, improving students' experience at recess, and connecting teachers and students across grade levels and buildings. One teacher suggested that design thinking could be used by larger groups at the school, such as the entire faculty at staff meetings. She explained,

> DT could be extremely useful during our staff meetings …we are always trying to solve some problem but it feels like we don't really go through the correct process of it…We talk about how frustrated we are but it's not productive when we are so sporadic. Design thinking creates that process we need…. We could ask questions to deeply learn about a problem, listen to each other, figure things out together, and go back if things don't work out. Something like this could really bring us together (K. Leger, personal communication, January 30, 2018).

Design thinking and classroom improvement. Other staff members discussed how design thinking could be a useful practice for developing and implementing lesson plans, units, and assessments. They explained how design thinking can be used as a valuable process on grade level teams to identify student needs, collaboratively brainstorm solutions, prototype new lessons and units, and experiment with teaching strategies. One specialist pointed out the value of iteration on such teams, when she said, "We would have to try these lessons and be open to failure, get feedback from kids and colleagues, and come back to the drawing board on our teams to prototype new and improved lessons" (V. Blue, personal communication, February 6, 2018). However, one participant cautioned that design thinking might not be successful when trying to augment existing curriculum because of the risks associated with change. As explained previously, the kindergarten team used the school's maker space to add an assessment at the end of a pre-existing (and very popular) unit on engineering structures. Even though the team chose to focus in this area, some of the kindergarten teachers struggled to innovate because the process required them to change something that already appeared to be working. This raises the question of whether design thinking is a more acceptable and useful practice when teachers are trying to solve a problem rather than augmenting something that does not require fixing.

Outcome Evaluation

The second goal of the dissertation was to measure the impact of the intervention on teachers' perceived CSE and WTR. Pre- and post-data were collected for the intervention and comparison groups to determine the relationships between the intervention and anticipated outcomes, as well as potential mediating variables. Next, the researcher checked to make sure that the items intended to measure each construct formed a scale or subscale with acceptable internal consistency reliability in this sample and that each item contributed positively to the

scale's reliability. Based on these results, scale scores were calculated by taking the mean value of the items that formed each scale. In order to determine the normality of the scale distributions, kurtosis and skewness were also tested. Basic descriptive statistics (mean, median, and standard deviation) were calculated for each subscale among the total population as well as for separate treatment and comparison groups. Lastly, parametric and non-parametric tests were utilized to measure potential relationships and differences between the treatment and control groups. After presenting the general, descriptive data collected from the study, the following section will answer the following outcome evaluation questions:

RQ3: Were there group differences in reports of CSE and WTR from the beginning to the end of the design thinking intervention?

RQ4: Were there group differences in teachers' perceptions of climate of psychological safety, climate of innovation, and knowledge sharing from the start to finish of the design thinking intervention?

RQ5: Did teachers' perceptions of climate of psychological safety, climate of innovation, and knowledge sharing mediate the association between participation in the intervention and CSE and WTR?

Descriptive Statistics

First, reliability coefficients were calculated to determine the internal consistency of scales (see Table 5.4). Among measures administered at pre-test, internal consistency was generally high with a range from $\alpha = .776$ for the perception of psychological safety scale to $\alpha = .932$ for the knowledge sharing scale and a median of $\alpha = .845$. At post-test, internal consistency was also high with a range from $\alpha=.662$ for the culture of innovation subscale 2 construct to $\alpha=.911$ for the knowledge sharing scale and a median of $\alpha=.832$. Second, skewness and kurtosis

were calculated for each measure (see Table 5.5 below). Although most of these measures have yielded normal distributions in larger populations (e.g., Tierney and Farmer's [2002] CSE scale), the small sample size involved in this study may explain why some of the distributions were not normally distributed.

Table 5.4

Reliability

Construct	Number of items	Reliability	
		Pre	Post
Willingness to Take Risks	8	.903	.832
Creative Self-Efficacy	8	.877	.864
Perception of Psychological Safety	7	.776	.907
Knowledge Sharing	4	.932	.911
Culture of Innovation Subscale 1	8	.845	.750
Culture of Innovation Subscale 2	3	.830	.662

Note. N=18

Table 5.5

Kurtosis and Skewness

	Intervention group				Comparison group			
	Kurtosis		Skewness		Kurtosis		Skewness	
Construct	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Willingness to Take Risks	-.638	-1.54	.694	.000	.242	-1.60	-.334	-.429

Creative Self-Efficacy	-.532	-.518	-.354	.008	-.417	3.46	-.066	1.85
Perception of Psychological Safety	2.22	-1.41	1.33	.500	-.232	.330	-.741	-.954
Knowledge Sharing	.138	-.314	-.654	-.004	-2.80	1.06	-.374	-1.37
Culture of Innovation Subscale	2.3	.538	1.45	.952	-1.46	1.92	-.007	-1.38
Culture of Innovation Subscale 2	1.98	-.853	.760	.147	3.65	1.81	-1.65	-1.24

Table 5.6 below shows the means, medians, and standard deviations for each scale among the total study population (N =18). Overall, teachers involved in the study agreed that their work on teams involves knowledge sharing and feel psychologically safe. They also indicated relatively high levels of WTR, one of the study's dependent variables, on the pre-test (*M*=3.26, *SD* = .457) and post-test (*M*=3.46, *SD* = .359) tests. The second dependent variable, CSE, had a pre-test mean of 2.94 (SD = .453) and post-test mean of 3.14 (SD = .381). In comparison, teachers in the sample reported lower scores on Culture of Innovation Subscale 2. Specifically, the low pre-test and post-test scores of teachers on the Culture of Innovations Subscale 2 (pre-test M = 2.18, SD = .628; post-test M = 2.22, SD = .498) indicated that teachers perceive they do not have the time and resources to innovate.

Table 5.6

Scales Mean, Median, and Standard Deviation (N=18)

	M		Median		*SD*	
Construct	Pre	Post	Pre	Post	Pre	Post
Willingness to Take Risks	3.26	3.46	3.25	3.50	.457	.359
Creative Self-Efficacy	2.94	3.14	3.00	3.00	.423	.381
Perception of Psychological Safety	3.29	3.41	3.28	3.39	.445	.447
Knowledge Sharing	3.46	3.42	3.50	3.37	.537	.542
Culture of Innovation Subscale 1	3.03	3.01	2.94	3.00	.406	.282
Culture of Innovation Subscale 2	2.18	2.22	2.00	2.33	.628	.498

Table 5.7 presents mean pre-test and post-test data for the intervention and comparison groups. In the treatment group, the dependent variable, WTR, increased by 7% from M = 3.16 to M = 3.38. However, the comparison group's WTR mean also increased (by 5%) from M = 3.43 to M = 3.59. The second dependent variable, CSE, shifted from M = 2.94 to M = 3.14 for the treatment group while there was little change to the mean score from pre- to post-test for the comparison group. Both the treatment and comparison groups indicated slight increases for the Psychological Safety scores from pre- to post-assessment.

Table 5.7

Pre/Post Means for Treatment and Comparison Groups

	Treatment group (*n*=11)	Comparison group (*n*=7)
	M	*M*

Construct	Pre	Post	Pre	Post
Willingness to Take Risks	3.16	3.38	3.43	3.59
Creative Self-Efficacy	2.82	3.08	3.14	3.23
Perception of Psychological Safety	3.21	3.41	3.43	3.41
Knowledge Sharing	3.39	3.27	3.57	3.64
Culture of Innovation Subscale 1	2.98	2.95	3.11	3.11
Culture of Innovation Subscale 2	1.97	2.15	2.52	2.33

Baseline Equivalence Testing

To examine the equivalence at baseline of the treatment and control groups, the researcher computed the difference (in unstandardized and standardized units) between the groups on each construct at pre-test. One-way ANOVAs were then used to test the statistical significance of these mean differences between the groups at baseline (see Table 5.8 below). Baseline equivalence refers to group similarities prior to the implementation of a program. Generally speaking, if a treatment group is similar to a comparison group at baseline (e.g., the group means differ no more one quarter of a standard deviation prior to implementation of the program), then adjusted mean differences that emerge after treatment may serve as quasi-experimental estimates of the "impacts" of the program on these outcomes. Unfortunately, at pre-test, the treatment group had a substantially lower score on every construct and these standardized mean differences (Δ) ranged from -.28 to -.96 across the seven scales. The largest difference at baseline between the treatment and comparison groups (d = -.55, Δ = -.74) was on the Culture of Innovation Subscale 2, which focuses on teacher access to resources and time for innovation. The difference between groups on this subscale, based on an ANOVA, approached

significance F = 3.89 (1, 16), p = .066, Δ = -.74 while all the other pre-test differences were non-significant in this small sample study. A non-parametric Mann-Whitney U Test was also conducted on the Culture of Innovation Subscale 2 because of the scale's non-normal distribution in this sample. This test found a significant difference between the distributions of intervention and control groups on this subscale at pre-test (p = .044). The difference between distributions of the two groups on this measure at baseline is depicted in a box and whisker plot in Figure 5.1.

Table 5.8

Pre-test Scores for the Intervention and Control Groups: Testing Baseline Equivalence

Construct	Treatment group *M* (*n*=11)	Comparison group *M* (*n*=7)	Eta squared (*N*=18)	Effect size[a] (Δ)	*p* of difference
Willingness to Take Risks	3.16	3.43	.087	-.66	.234
Creative Self-Efficacy	2.82	3.14	.148	-.96	.114
Perception of Psychological Safety	3.21	3.43	.062	-.38	.319
Knowledge Sharing	3.39	3.57	.030	-.33	.493
Culture of Innovation Subscale 1	2.98	3.11	.026	-.28	.524
Culture of Innovation Subscale 2	1.97	2.52	.196	-.74	.066

[a] Difference between treatment and comparison group means divided by standard deviation of the control group.

Figure 5.1. Pre Means for Culture of Innovation (Subscale 2)

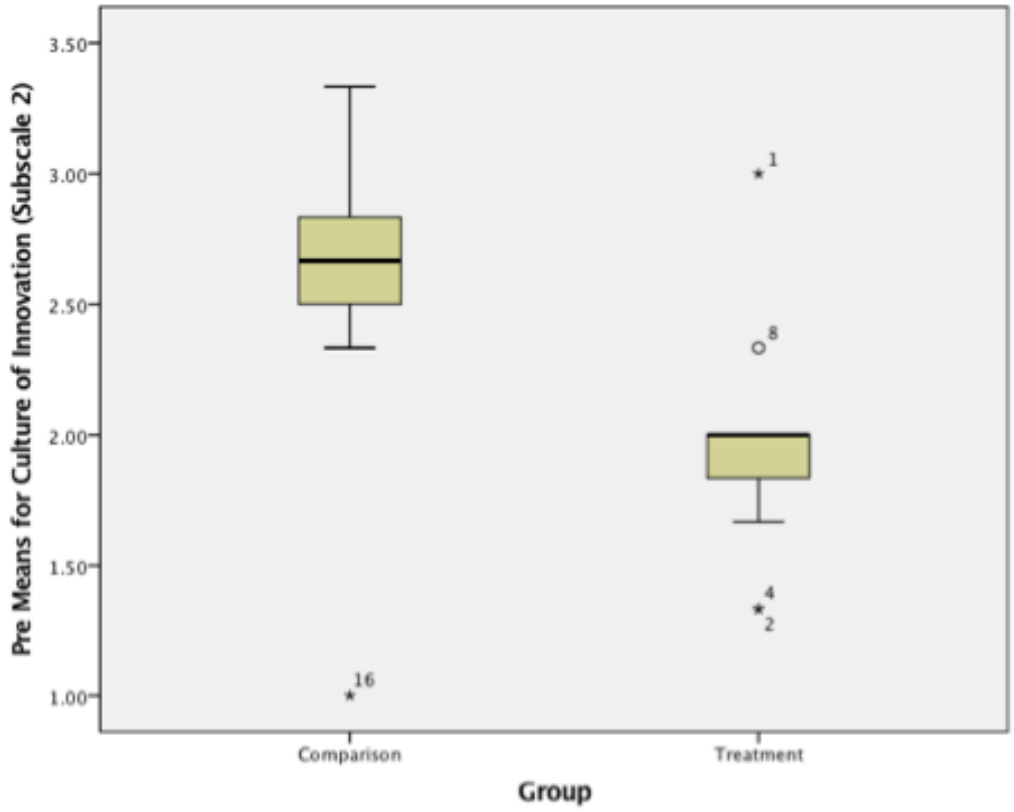

Figure 5.1. This box and whiskers plot indicates the difference between distributions of the two groups at baseline on the Culture of Innovation (Subscale 2) measure.

Short and Medium Outcome Analyses

Since the comparison group scored higher on all measures at baseline, the researcher controlled for teachers' baseline scores in estimating the program's "impact" on each outcome. That is, each impact analysis estimates the program's impact by comparing the adjusted means of the groups, with each adjusted mean indicating the post-test score predicted for the "average" teacher (a teacher who was at the grand mean of the entire sample on the pre-test measure of the outcome). Thus, if the treatment group has a higher adjusted mean than the comparison group on

a particular outcome, it indicates that the treatment group members showed more growth in that outcome than did the comparison group.

Specifically, a separate multiple regression analysis was conducted for each outcome. In these analyses, a teacher's post-test score (the dependent variable) was predicted based upon their group (the independent variable) and their pre-test score (grand-mean-centered so that this covariate indicates how far above or below the grand mean of the sample the teacher was at pre-test).

The results (see Table 5.9 and Table 5.10 below) indicated that the estimated impacts of the intervention were non-significant. Some of the effect size estimates were moderately negative and some were moderately positive; the effects ranged from -.462 to .291.

Table 5.9

Group Differences in Adjusted Means at Post-Test

Construct	Treatment group adj. *M* (*n*=7)	Comp. group adj. *M* (*n*=7)	Estimated impact	Comp. group *SD* (post)	Effect size[a]	*p* of estimated impact
Willingness to Take Risks	3.43	3.51	-.08	.359	-.223	.579
Creative Self-Efficacy	3.15	3.11	.04	.371	.108	.829
Psychological Safety	3.47	3.31	.16	.550	.291	.351
Knowledge Sharing	3.33	3.55	-.22	.476	-.462	.151
Culture of Innovation Subscale 1	2.96	3.09	-.13	.378	-.344	.352
Culture of Innovation Subscale 2	2.26	2.16	.10	.694	.144	.679

[a] Effect size refers to the difference between treatment and comparison group means, divided by the standard deviation of the control group means. Impact estimates were calculated from a multiple regression model that controlled for a grand M centered version of pre-test variables.

Table 5.10

Multiple Regression Analysis

	Predictors of Initial and Intermediate Outcomes					
	Initial Outcomes				Intermediate Outcomes	
Predictors	Psychological Safety B	Knowledge Sharing B	Culture of Innovation 1 B	Culture of Innovation 2 B	Willingness to Take Risks B	Creative Self-Efficacy B
Constant[a]	3.31***	3.55***	3.09***	2.16***	3.51***	3.11***
Pre-Intervention Measure of Outcome[b]	.73**	.80**	.21**	.50**	.50**	.58**
Treatment[c]	.16	-.22	-.13	.10	-.08	.04
R^2	.49	.73	.17	.357	.45	.40
F	7.2**	20.7**	1.48**	4.17**	6.22**	4.91**

Note. $N = 18$

[a]This coefficient indicates the adjusted mean of the outcome in the comparison school.

[b]The pre-intervention measure was grand-mean-centered.

[c]This coefficient indicates the difference between the adjusted means of the treatment group and the comparison group.

†$p \leq .10$ *$p \leq .05$ **$p \leq .01$ ***$p \leq .001$

Given the small size of the sample and the non-normal distribution of some of the outcomes in this sample, a second set of impact analyses were conducted using non-parametric techniques on teacher's gain scores from pre-test to post-test on each outcome. For these analyses, a Mann-Whitney U test compared the distribution of gain scores in the two groups on each outcome. A median test compared the median gain scores of each group. These non-parametric tests indicated significant differences between the groups on the Culture of

Innovation Subscale 2. Gains from pre-test to post-test were significantly more prevalent for the intervention group than the comparison group (p = .035 for the U test and p = .013 for the median test). Figure 5.2 below illustrates these findings. These findings suggest that the design-thinking program may have boosted teachers' perception of an enhanced culture of innovation at Gates (in terms of access to time and resources to innovate). Note, however, that one of the 11 teachers at Gates was an outlier: This teacher perceived a deterioration in the culture of innovation at Gates that was counter to the improved culture reported by the other participants in the design group.

Figure 5.2 Gains in Culture of Innovation (Subscale 2)

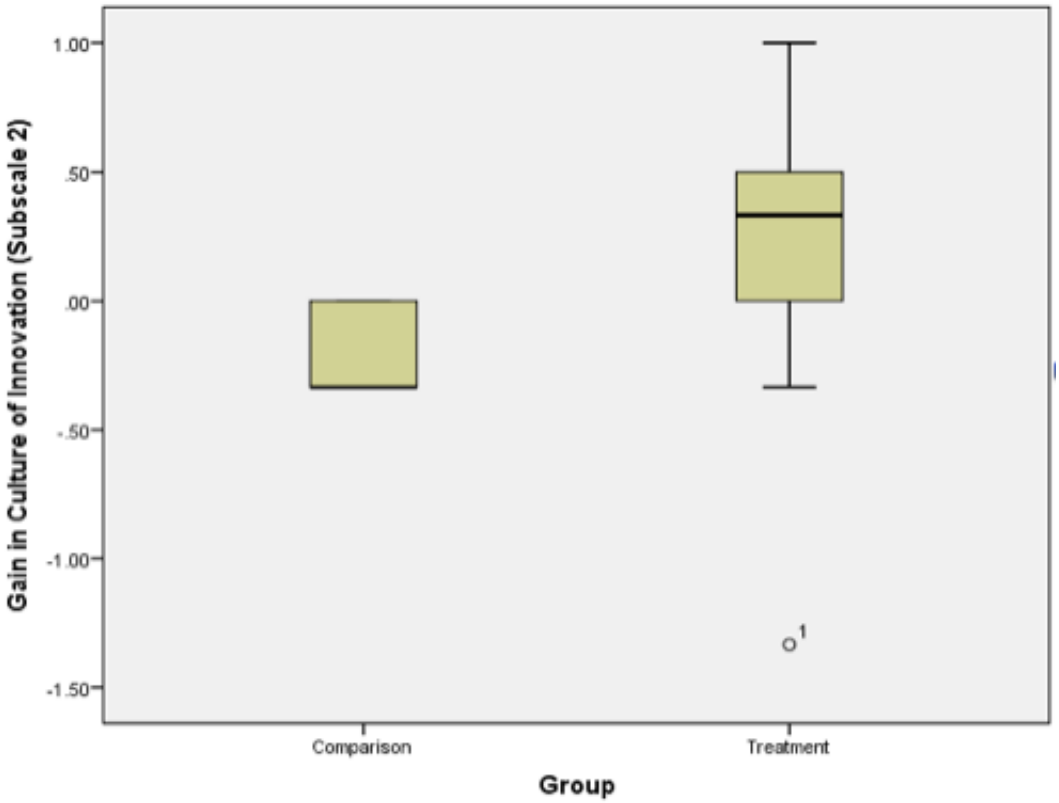

Figure 5.2. This box and whiskers plot indicates gains from pre-test to post-test on the Culture of Innovation (Subscale 2) measure for both the treatment and comparison groups.

Findings Related to RQ3, RQ4, and RQ5

The remainder of this section will summarize data analyses in relation to the outcome evaluation questions. The first research question discussed in this section (RQ3) asked whether there were group differences in reports of CSE and WTR from the beginning to the end of the intervention period. As described above, there were no significant changes in these two dependent variables, when comparing the intervention to the comparison group. Multiple regression analyses indicated that p = .829 for CSE and p =.579 for WTR (see Tables 5.9 and 5.10 above). The second question (RQ4) asked whether there were group differences in teachers' perceptions of climate of psychological safety, climate of innovation, and knowledge sharing from the start to finish of the intervention period. Non-parametric analyses (see above) found a significant change from pre-test to post-test for Climate of Innovation Subscale 2, with the intervention group showing greater gain in climate of innovation than the control group. The final research question (RQ5) asked whether teachers' perceptions of climate of psychological safety, climate of innovation, and knowledge sharing mediated the association between participation in the intervention and CSE and WTR. As described above, results of the main effects analyses suggested that participation in the intervention was not significantly associated with CSE and WTR; therefore, these mediation analyses were not conducted.

Discussion

The overarching goal of the dissertation study was to determine whether exposure to a design thinking intervention over three months would increase teachers' CSE and WTR. In the results section, quantitative and qualitative data were analyzed separately to answer process and outcome evaluation questions associated with the researcher's theory of treatment. In the following section, the two data strands will be mixed when appropriate to interpret the study's main findings. Literature will be presented throughout the discussion to inform and contextualize

the results. Study limitations will then be presented, followed by a discussion of the study's contributions to theory and practice.

Summary of Findings

Creative self-efficacy. The study hypothesized that Gates teachers would report higher levels of CSE at the end of the design thinking intervention. As explained in the results section, mean CSE scores increased on the intervention teams from pre- to post-intervention. However, this net increase was insignificant when changes to the comparison group's CSE scores were factored into the multiple regression analysis. The qualitative data enabled a richer understanding of teachers' perceptions of CSE over time. Multiple participants shared that their confidence in the creative process increased as they gained more experience with design thinking. By exploring these interview responses through the lens of social cognitive theory, it was clear that some teachers experienced multiple sources of self-efficacy (Bandura, 1977). As Jobst and Meinel (2012) speculated, the process of working on a design thinking team exposed participants in this study to vicarious learning opportunities and social persuasion. In particular, participants spoke about the positive impact of vicarious opportunities, which involved observing the consultant (at the training), facilitator, and teammates successfully using the process. Additionally, some participants cited the use of social persuasion by the facilitator (i.e., the transformational leadership component of the intervention) as a key motivator. While participants felt more adept using the process over time, there is no indication that mastery was achieved. This finding is critical, as literature on self-efficacy suggests that mastery experiences are the most important source of increased CSE (Bandura, 1996; Tierney & Farmer, 2002). It is possible that a longer intervention (e.g., Mathisen & Bronnick, 2009) would have resulted in mastery experiences and a significant finding for the CSE scale.

***Solutionitis*.** Another key finding related to teacher creativity was the important role design thinking played in reducing teachers' propensity for *solutionitis*. Bryk, Gomez, Grunow, and LeMahieu (2015) define *solutionitis* as the tendency "to jump quickly on a solution before fully understanding the exact problem to be solved" (p. 197). The consequence of such quick, siloed thinking is the incomplete understanding of a problem, which can result in unproductive and unimaginative responses. Teachers at Gates explained how policy overload and lack of time combine to encourage quick decision-making in their classrooms and school. This finding is consistent with studies by Knapp et al. (1998) and Valli and Buese (2007), which found that teachers are overwhelmed by constant and sometimes overlapping changes, and therefore lack the bandwidth required for change initiatives. However, the design thinking intervention provided Gates teachers with the time and structure they needed to slow down, diagnose problems, and make decisions based on evidence.

A related finding in the study was the role of the first step of design thinking, empathy, in reducing teachers' propensity for *solutionitis*. Several teachers shared how they enjoyed and benefitted from opportunities to talk and listen to stakeholders when identifying problems to be solved. This finding was interesting on two levels. First, teachers at Gates genuinely craved both the time and a process that enabled them to actively listen and be heard by peers during the school day. School leaders who provide such opportunities via design thinking can potentially increase relational trust, collegiality, and other constructs associated with a healthy school culture and creative performance (Bryk et al., 2015; Bryk & Schneider, 2002). Second, the empathy step supported innovativeness by forcing participants out of their own world-view and into the needs and experiences of others. Liedka (2015) explains how collection of deep data on user needs and perspectives reduces the effects of cognitive bias. Empathy practices mitigate the

proclivity of teachers to make biased decisions based on emotional states, past experiences, or personal preferences. Instead, design thinking focuses attention directly on user needs and paves the way to more useful and innovative solutions.

Risk taking and iteration. Risk taking on the design teams was largely supported by the iterative nature of the design thinking process. Participants expressed how the experimental nature of design thinking freed them from self-imposed expectations of perfection. Specifically, opportunities to fail early and often in a psychologically safe environment reduced the risks associated with innovation (Carlgren et al., 2016). This is consistent with findings from other researchers who report that failure supports risk taking and innovation, so long as it acts as a source of learning (Fraser, 2009; Schweitzer et al., 2016). While Gates participants broadly credited the opportunity to iterate as the underlying reason for their willingness to learn from failure, Brown and Wyatt (2010) focused on the specific value of the prototyping step. "A vibrant design thinking culture will encourage prototyping—quick, cheap, and dirty—as part of the creative process and not just as a way of validating finished ideas" (p. 35). This indicates that school leaders can support climates of innovation by fostering opportunities for teachers to prototype, fail, reflect on failure, and innovate through a process of continuous improvement.

Psychological safety and risk taking. A second key factor associated with teacher risk taking on the design thinking teams was the perception of psychological safety. Quantitative data revealed that teacher participants experienced a positive but not significant growth in the psychological safety indicator. The qualitative data were more definitive, as 11 out of 11 participants discussed the importance of psychological safety to their WTR on the design teams. They shared how baselines of trust and comfort were needed before they were willing to "go out on a limb" with others. This finding is consistent with Edmondson's (2003) formative work on

psychological safety, which indicates that "individuals engage in a kind of tacit calculus at micro-behavioral decision points, in which they assess the interpersonal risk associated with a given behavior" (p. 4). In the absence of a safe, comfortable setting, employees will focus on self-preservation over risk taking, productive conversation, and the accomplishment of shared objectives (Edmondson, 1999). Gates participants experienced psychological safety and thus were more willing to endure, and at times even embrace, uncertainties that accompanied the design thinking process.

Transformational leadership. As hypothesized, participants explained how higher levels of psychological safety were, in part, made possible by transformational leadership practices used by the intervention's facilitator. The researcher's theory of treatment suggested that transformational leadership was needed to inspire, motivate, and intellectually stimulate participants as they experienced the risks and vulnerability associated with design thinking. As explained in the results section, 90.9% of participants recognized all four components of transformational leadership style (idealized influence, inspiration, intellectual stimulation, and individual consideration) in the facilitator's approach to leading the design teams. Qualitative data obtained through the interviews fleshed out specific aspects of transformational leadership that promoted creative confidence, risk taking, and innovative behavior. In relation to psychological safety, teachers felt that the coaching-oriented, collaborative, and flexible approach used by the facilitator fostered a sense of security and trust. Popper and Mayselles (2003) explain how exposure to these transformational leadership practices creates a "safe haven" and "secure base" from which team members can navigate risks and threat (p. 120). Carmeli et al. (2013) confirmed and augmented this assertion by directly linking employee exposure to transformational leadership to perceptions of psychological safety and creative

problem solving capacity.

More generally, the transformational leadership practices of idealized influence and inspiration were particularly powerful drivers of innovativeness on the design thinking teams. With regards to idealized influence, teachers expressed that the facilitator was a role model who exemplified the risk taking and values that were expected of them. Studies conducted by Groeger and Schweitzer (2015) and Jung et al. (2003) support the notion that such "charismatic behaviors" create a collective identity on teams that is supportive of collaboration and innovation. Inspiration was also cited as a key contributor to participant risk taking and innovation on the teams. At Gates, teachers explained how a clearly articulated vision of the design thinking intervention motivated and energized them to transcend their own self-interests while pursuing their group's problem solving goals. One striking commonality across teacher comments was the need for explicit permission to partake in design thinking activities instead of more traditional collaborative methods. Literature on teacher collaboration confirms that teachers will stick to tried and true methods of collaboration unless supported to experiment with new practices (Leithwood, 1990). Leaders who prioritize the use of design thinking through vision and the provisioning of time/resources empower employees to assume the risks associated with a change to practice (O'Connell, Hickerson, & Pillutla, 2011; Zaccaro & Banks, 2004). By enabling these opportunities, transformational school leaders directly support teachers to develop and implement pedagogies known to foster knowledge economy skills.

However, teachers noted that too much leadership input and direction might impede the successful use of design thinking in an educational setting. Multiple participants felt that involvement should be participatory in nature and not burdened by excessive norms or rules of engagement. In support of these statements, the literature suggests that participatory leadership,

which encourages joint decision-making and shared influence, promotes creative outcomes and innovativeness on teams (Sagie et al., 2002). In contrast, other studies speak to the importance of a more directive leadership approach, especially when teams comprised of professionals from different disciplines are working together (Somech, 2006). As will be explained below, such functionally heterogeneous teams can experience a myriad of challenges in the absence of direct leadership. Sagie (1997) suggests that participative and directive approaches are not opposing poles, but can go hand-in-hand in supporting innovative work in a team setting. In a study on the role of leadership in encouraging innovation on functionally heterogeneous teams, Somech (2006) found that the participatory approach fostered creative knowledge sharing while the directive approach provided the vision and explicit instructions teams needed to function. This finding helps to explain why/how transformational leadership, which includes elements of both participatory and directive styles, complements design thinking (Groeger & Schweitzer, 2014).

Culture of innovation. Transformational leadership also contributed to teachers' perceptions of a culture of innovation at Gates. As indicated above, a positive and significant finding was discovered for the Culture of Innovation Subscale 2 measure (which focused on teachers' perceptions of available time and resources for innovation at Gates). The qualitative results provide some clues for why teachers may have perceived improvement in this area. Generally speaking, teachers shared the feeling that support from leadership, the feeling of psychological safety, and the availability of time and space to innovate on a PLC/CoP created a culture of innovation that made risk taking and creative performance possible. When considering school climate at the end of the intervention, participants possibly viewed the intervention as an investment in them as professionals. However, it is also possible that factors beyond the intervention (e.g., the actions of a popular new principal) explain this result. While the

significant finding is encouraging, additional research is needed to determine the extent to which design thinking can be used to foster a culture of innovation that inspires creative teacher performance.

The value of professional diversity on design thinking teams. This dissertation raises interesting questions regarding the ideal composition of design thinking teams in school settings. On the one hand, the presence of trusted colleagues from grade level teams was identified as an essential, comforting factor that promoted risk taking and innovativeness. Some grade level teachers explained that it would have been challenging, if not impossible, to take the risks associated with design thinking if their teams included staff members they did not know and like. At the same time, the contributions of specialists to knowledge sharing, particularly in the ideation/brainstorming step, was cited as an especially valuable contributor to design thinking success. This reflects a common theme found in the creativity and design thinking literature: Diverse perspectives in groups can substantially enhance innovative behavior and performance (Amabile et al., 1996; Brown, 2008; Seidel & Fixson, 2013). Thus, a challenge emerges for school leaders who seek to create psychologically safe teams that facilitate interpersonal risk taking while also harnessing the knowledge sharing that accompanies functional heterogeneity on teams.

The business literature sheds light on how school leaders can balance psychological safety with diversity on teams. According to Jackson (1996), "To be maximally effective, multidisciplinary teams must successfully manage the assets and liabilities associated with their diversity" (p. 54). This begins with an understanding of some of the unique challenges that can emerge on functionally heterogeneous teams, such as ineffective communication, power/status imbalance, lack of cohesion, and poor decision-making quality (Martinize, Zouaghi, & Marco,

2016). These issues can impede organizational growth and innovation by fueling unproductive conflict, burnout, and turnover (Somich, 2006). When composing and supporting functionally heterogeneous design thinking teams, strong leadership is needed to: a) develop a comfortable working space (e.g., through ice breakers); b) scaffold the process so it is manageable; c) create opportunities for open engagement and disagreement; and d) manage conflicts when they arise (Brown, 2008; Jackson, 1996). Teacher participants at Gates also suggested that leaders must make efforts to ensure that workload is equal for all members across the design teams to minimize resentment that could erode trust. More research is needed to determine how leaders and team members in an educational context can create the conditions needed to simultaneously support psychological safety and diversity on design teams.

One surprising finding related to team dynamics involved the reported decrease in knowledge sharing from the beginning to the end of the intervention. This was in contrast to the intervention theory of treatment, which hypothesized that exposure to the treatment would promote knowledge sharing opportunities for teachers on each design team (see Appendix D). It is possible that the slight friction and challenges experienced by members on the functionally heterogeneous teams accounted for this unexpected finding. An alternative explanation for the negative change in knowledge sharing could be the time of year when the intervention took place. As explained previously, multiple teachers reported how challenging it was to find the time and energy needed to collaborate on design teams during the holiday session. It is highly plausible that teachers also struggled to find time to share curricular ideas, know-how, and expertise during this especially fragmented and busy time of year.

Task compatibility with design thinking. The study also raises questions regarding whether some types of tasks are more compatible with the design thinking process than others in

K-12 schools. In their formative work on the design process, Buchanan (1992) and Martin (2009) discussed the power of design thinking to solve "wicked problems" that are messy, ill defined, and mysterious. But are there some tasks that are better to approach with design thinking than others in a public educational setting? Over the course of the intervention, participants chose to use design thinking to problem solve in three different areas: a) school-wide challenges (e.g., chaos at kindergarten lunch); b) issues that emerged when developing a complex new project (e.g., the maker space lunch box activity); and c) problems that came up when augmenting an existing unit (e.g., the kindergarten engineering unit). Qualitative data revealed that design thinking sparked innovative thinking and risk taking when used to resolve school-wide issues and developing the lunch box project. In contrast, evidence suggested that the process was less effective for the popular engineering unit, which required teachers to alter an already beloved project. When examined through the lens of Yates and Stone's (1992) risk taking framework, it is possible that the kindergarten team was more reluctant to use design thinking in this context, even though they chose to focus on this area, because the threat of loss (in this case, changing an already working unit) outweighed potential gains. Additional research is needed to determine the extent to which design thinking is more or less effective when attempting to resolve "wicked" school-wide problems (e.g., building a master schedule) and address different types of challenges in the classroom (e.g., integrating technology into a PBL unit, developing new units, etc.).

Limitations

When evaluating the validity of the study's findings, multiple limitations must be considered. The researcher's prior role as vice principal at Gates from 2014-2016 may have influenced the results. On the one hand, his past leadership experience at Gates put him in a strong position to exert transformational leadership (as the design team facilitator) because he

was aware of the school community and had relationships with most members of the faculty. However, his prominent role in the intervention may have resulted in multiple threats to the internal validity of the study. For instance, it is possible that selection bias played a role for staff members who either wanted to work with him due to positive past experiences or chose to avoid the study because of prior interactions. Once the sample at Gates was selected, participants in the study potentially said or did things to please the researcher due to the existence of a power dynamic. Some of these issues were mitigated by the fact that the researcher was no longer in a leadership role when the study was executed.

A second threat to validity was the researcher's subjectivity during the data collection and analysis components of the study. As explained in prior portions of the dissertation, the researcher had evaluated nine of the 11(82%) participants in the 3 years prior to the intervention. These pre-existing relationships potentially influenced how the researcher interacted with team members, asked interview questions, analyzed quantitative and qualitative data, and interpreted the results. While the researcher used a reflexivity journal to reflect on potential bias throughout the research process, it is still possible that the final results were influenced by bias.

A third limitation to the study involved the composition of the comparison group. As explained in Chapter 4, the researcher recruited a comparison group at the Lynch school to help inform a better understanding of the intervention's effects on Gates participants. Shadish, Cook, and Campbell (2002) explain the importance of closely matching the characteristics of intervention and control groups so as to mitigate threats to validity. Despite these efforts, one member of the intervention team (a special educator) dropped out of the study before it started and the researcher was unable to recruit the librarian at Lynch for the study. As such, the librarian at Gates was matched with the special educator at Lynch. It is likely that these, and

other, differences between the intervention and comparison groups may have influenced the quantitative results.

Fourth, the small size of the intervention sample posed threats to the internal and external validity of the study. The study sample included 11 staff members who worked with kindergarten and first grade students at Gates and 7 members in the comparison group at Lynch. This choice to deeply focus on a small subset of teachers was purposeful, as it reflected the researcher's desire to focus deeply on the experiences of a few teachers using the case study methodology. However, such a small number of participants limited the ability of the researcher to detect causal relationships among variables. Moreover, the small sample size made it challenging to determine whether moderating variables (e.g., years of teaching experience or tenure at school) changed the strength of relationships between the independent, mediating, and dependent variables. In relation to external validity, the limited focus of the study reduced the generalizability of findings to other schools and settings. A second threat to external validity was the explicit focus on teachers working with early education students. It is possible that the findings would have been different for teachers employed at the later elementary, middle, and high school levels.

Finally, the short duration of the intervention may have also influenced the results of the study. Members of the intervention met only seven times for 20 total hours over a three-month period, which included a 4-day Thanksgiving vacation and a two-week Winter break. Similar studies that have discovered significant findings were carried out over more total hours. For instance, Mathisen & Bronnick (2009) implemented a multi-day intervention to measure the impact of a university course on student creativity on CSE. They observed significant increases in student levels of self-efficacy after 5 full days of treatment. Additional exposure to the design

thinking treatment at Gates could have potentially increased CSE and reduced the risks associated with innovation.

Implications for Theory and Practice

Despite these limitations, this dissertation informs theory and practice in multiple ways. The study extends Ford's (1996) theory of individual creative action (TICA) by demonstrating that usage of design thinking under the right conditions increases the likelihood that teachers will choose creative over habitual action. The study revealed multiple individual and contextual factors that increased the likelihood of teacher innovation despite the presence of institutionalism. The qualitative data, in particular, indicated that design thinking facilitates creative action by providing opportunities for teachers to experiment and learn from failure through iteration. The empathy and brainstorming steps increased creativity and innovation by empowering teachers to resist "soltitionitis" and share knowledge with colleagues on functionally heterogeneous teams. The second element of the intervention, transformational leadership, put teachers on a path to creative action by reducing risks associated with innovation. Specifically, the use of inspiration and idealized influence helped to foster climates of psychological safety and innovation that promoted interpersonal risk taking. Finally, the PLC/CoP structure served as a valuable antecedent to creative action, as teachers benefitted from increased access to time, resources, and a common vision.

The study also extends TICA by highlighting factors that motivated teachers to select habitual over creative action when engaged in design thinking work. Teachers may avoid components of the design protocol that involve risk taking if they feel uncomfortable with colleagues on the team or their leader. The path to creative action may also be impeded if the design team leader applies a top down approach that is inflexible and non-participatory in nature.

However, teachers will also revert to more traditional, safer methods if the leader does not provide a strong vision for the group or guidelines for navigating a complex design thinking process. The need for a balanced leadership approach becomes even more evident when the complexities involved with managing functionally heterogeneous teams are considered. Lastly, the design thinking protocol may be unsuccessful, and potentially harmful to team dynamics, if the "wicked problem" or area under focus is not carefully selected. Teachers may lose motivation to create if asked to revise what they perceive to be an already successful lesson, unit, assessment, or school-wide practice.

This dissertation further contributes to social cognitive theory by linking CSE to innovative performance. Increased creative confidence, made possible by the iterative nature of design thinking and supportive leadership and colleagues, helped participants to persist in risky, creative endeavors. Qualitative results indicated that two sources of CSE, vicarious learning opportunities and social persuasion, contributed to participants' confidence in their ability to innovate. When viewed from the perceptive of TICA, this increased CSE can be viewed as a factor that motivated teachers to choose creative over habitual action. However, teachers did share that they did not have the opportunity to accomplish the most important source of CSE, mastery, when engaged in the intervention. Given the many skills required for design thinking work, it is not surprising that participants were unable to master the process in 20 hours. Additional research is needed to determine whether longer exposure to the process will result in mastery experiences.

In terms of practice, this exploratory study revealed that design thinking is a promising tool for school leaders who wish to increase innovativeness in their buildings. Design thinking can be used to tap into the collective expertise of faculties to solve both school-wide and

classroom challenges. Exposure to the process can provide teachers with the confidence and WTR they need to develop and implement innovative pedagogies known to foster knowledge economy skills. School districts can support such efforts by providing training in the design thinking process to principals and teachers. Moreover, district leaders can indirectly support successful use of design thinking by hiring and developing transformational leaders who can provide the inspiration and guidance needed for the process to work. At the building level, principals enable the successful use of design thinking by developing climates of innovation and psychological safety. These efforts must include the articulation of a vision that gives permission for teachers to use the design thinking process to innovate, even if traditional norms are challenged. Finally, strong leadership is needed to manage the challenges and opportunities that arise when functionally heterogeneous design thinking teams collaboratively solve problems.

Given the exploratory nature of the study, additional research is needed to shed light on the above findings. Future research can focus on larger samples of educators, which may provide the statistical power needed to detect causal relationships. The external validity of future results can be improved by measuring the experiences of teachers working across different types of schools (public and private), grade levels, and regions of the country. Additional research is also needed to determine how transformational leaders can create opportunities for teachers to experience mastery, a vital source of CSE, when engaging in the design thinking process. Lastly, future research can examine what types of tasks are best approached using the design process, and in what forums (e.g., small PLCs/CoPs or faculty meetings).

Conclusion

At the broadest level, this dissertation sought to address the myriad challenges school leaders encounter when attempting to modernize K-12 public schools. As explained in Chapter 1,

most schools are frozen in time, looking strikingly similar to "factory model" institutions of the Industrial Era. At that time, the goal of schooling was to assimilate immigrants entering the country and prepare students for work on assembly lines. Practices that accomplished these goals (e.g., standardized assessment and dividing knowledge into separate subject areas) are still featured in American schools, even though the demands of modern employers and society have radically changed. In today's knowledge economy, employers demand workers capable of collaboration across cultures, flexible and critical thinking, creativity, application of technology, and innovation. Moreover, pressing global crises, such as economic inequality and environmental decline, require the attention of collaborative, entrepreneurial thinkers. A wide body of research suggests specific practices teachers can use to engender these knowledge economy skills, yet schools cling to past practice and traditions from another era.

After applying theories of institutionalism and risk taking to understand these seemingly insurmountable impediments to change, this dissertation identified a potential solution—the use of design thinking to spark innovation. The findings indicate that, under the right conditions, the design thinking protocol can help teachers to overcome the vulnerability, threat, and risk associated with innovative change. The process can be used to tap into teachers' collective expertise to solve school-wide problems and develop practices that foster knowledge economy skills. Despite these promising findings, one must ask whether incremental changes, made possible by design thinking, can truly counter the powerful effects of institutionalism. In and of itself, the answer is probably no. However, the confluence of mounting pressures for change, the development of new models on the periphery of public education, and the use of practices like design thinking within existing public schools, can lead to transformative change. Meyer (2006) explains how a proliferation in entrepreneurial for-profit, non-profit, and charter school

organizations is beginning to fray away at the legitimacy of the factory model. By using design thinking to innovate from within, public school leaders contribute to the possibility that a new model, which reflects 21st century priorities, will take hold.

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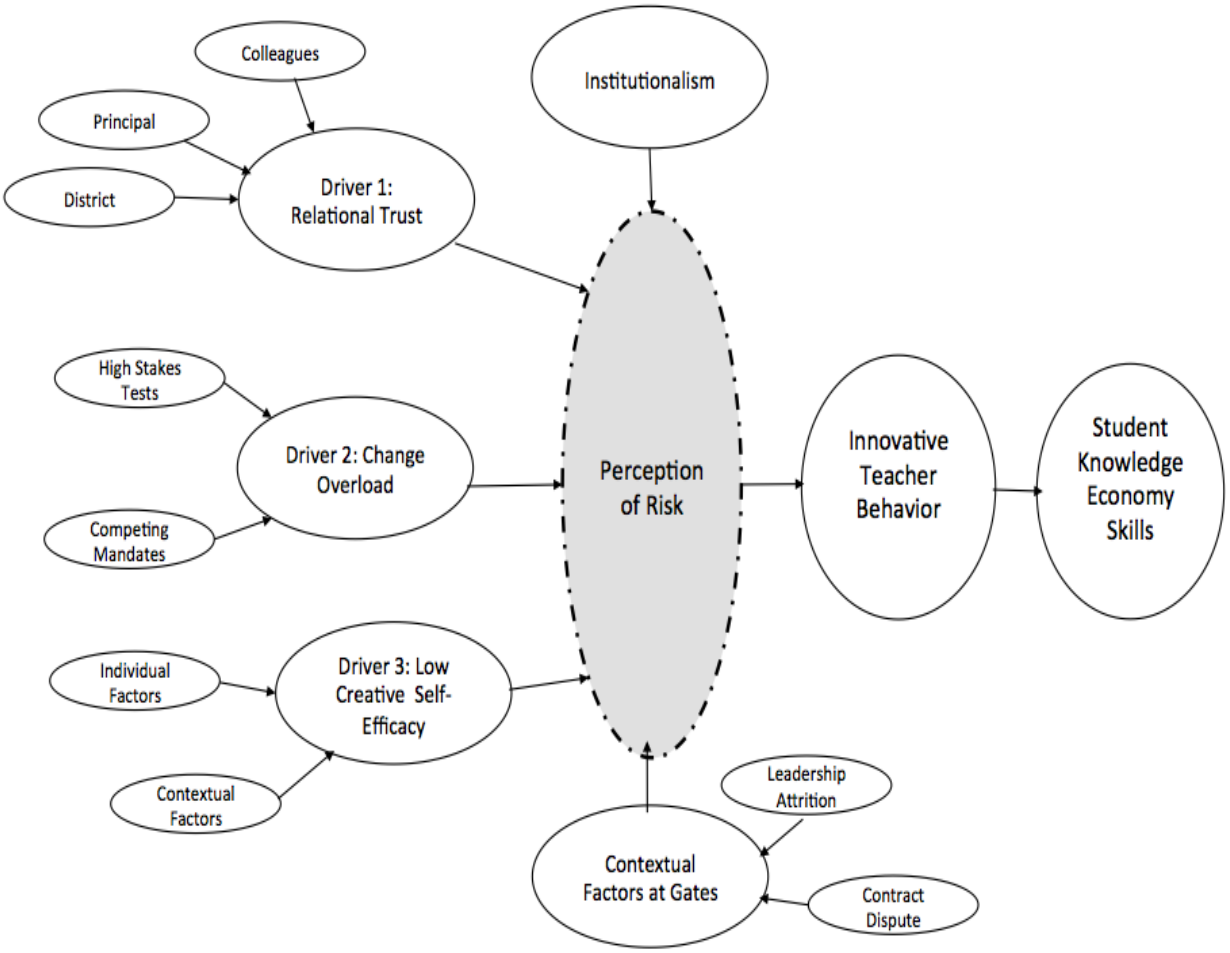
Appendix A

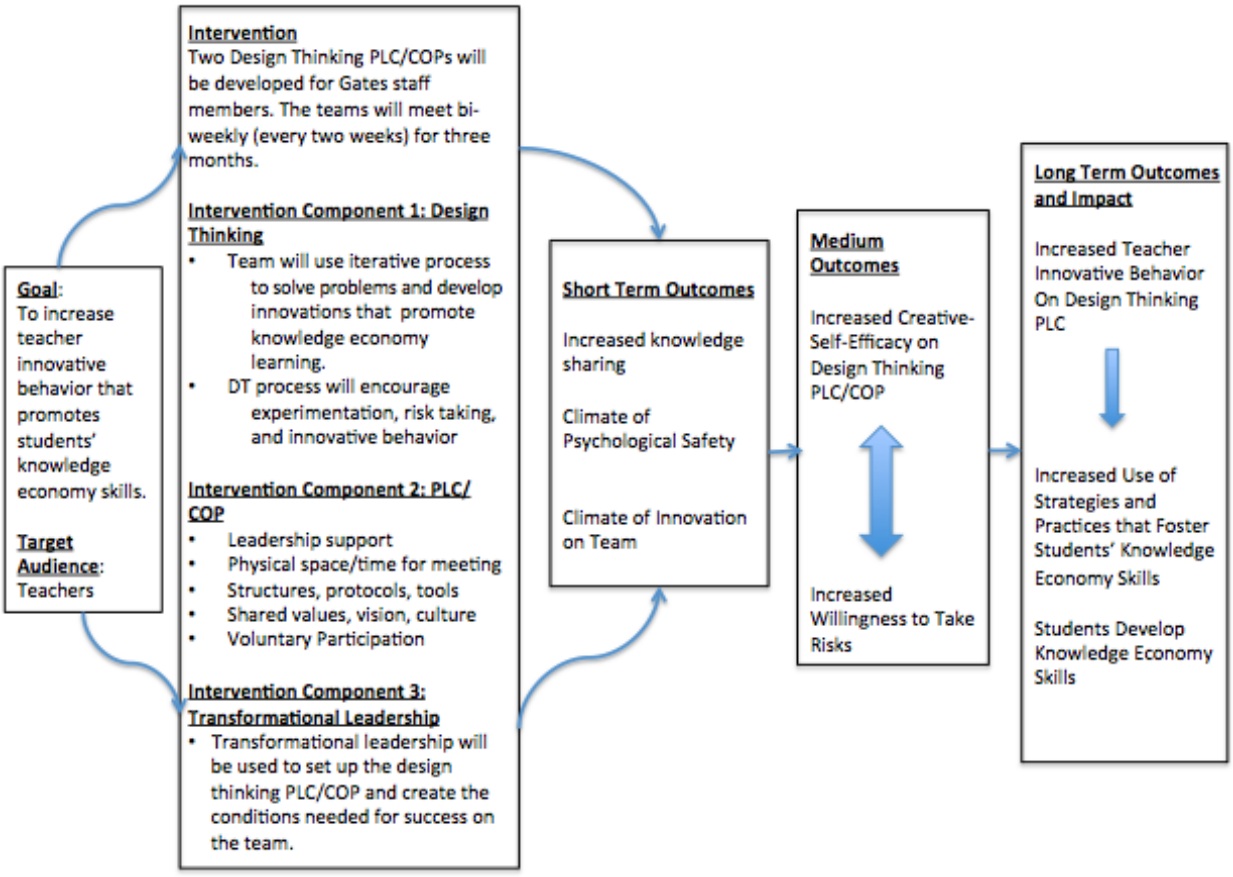
Concept Map



Note. This concept map shows how different factors can increase (or decrease) teachers' perceptions of risk and thereby lower (or raise) innovative teacher behavior and student knowledge economy skills.

Appendix B

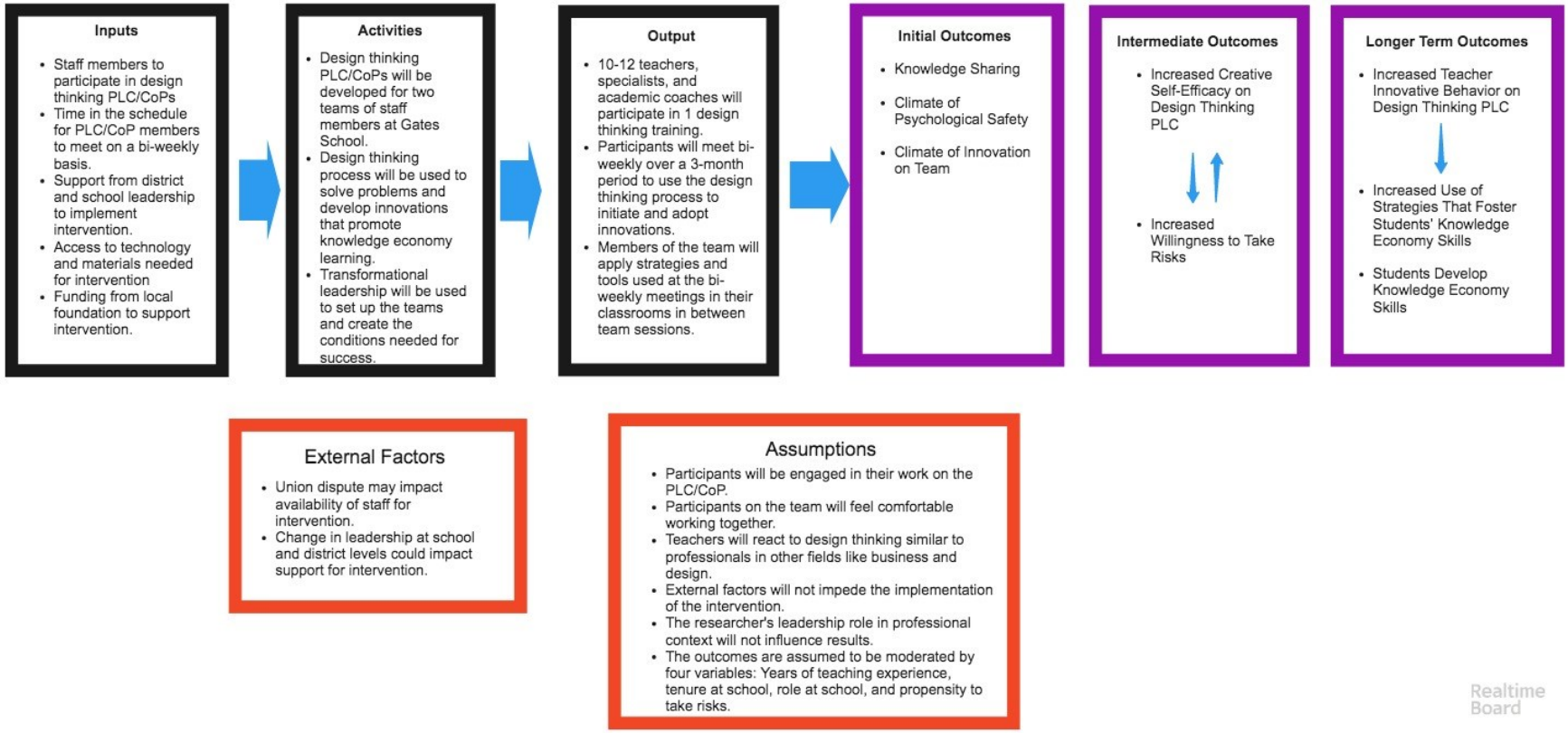
Theory of Change Diagram



Note. The theory of change diagram illustrates the theory behind the design thinking intervention.

Appendix C

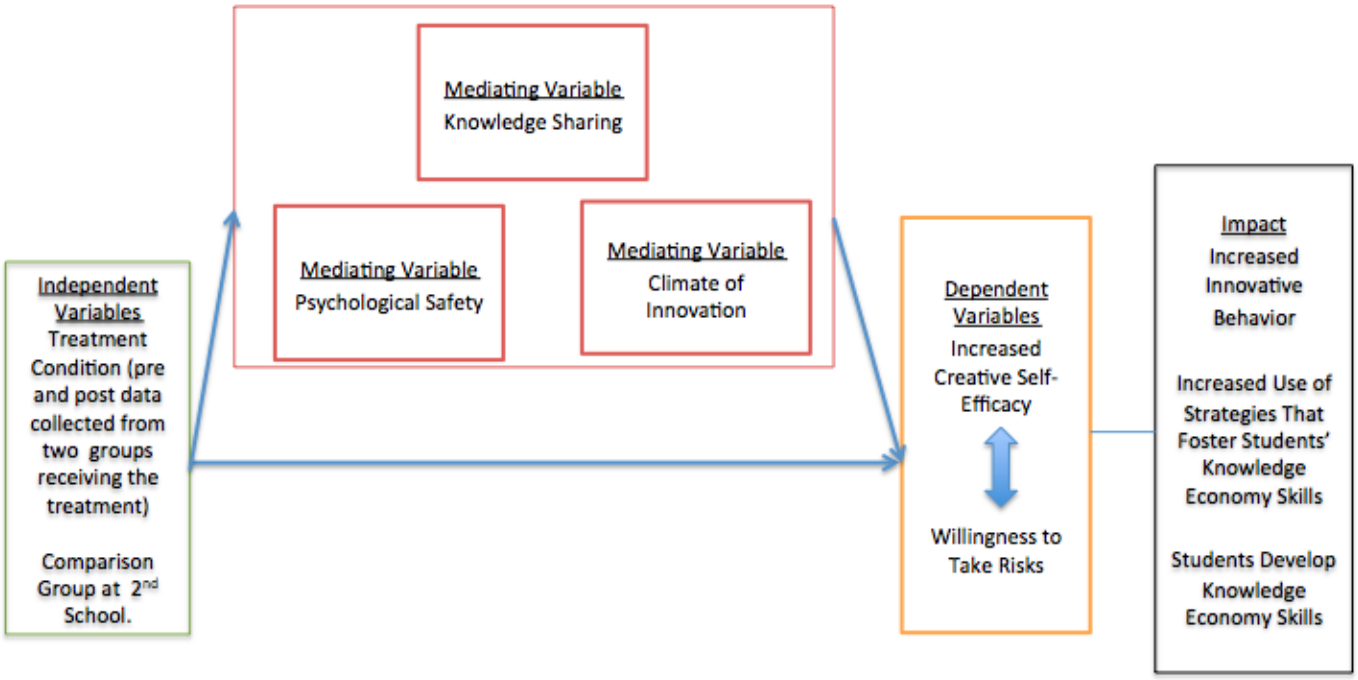
Intervention Logic Model



Note. This diagram illustrates the logic model for the design thinking intervention.

Appendix D

Theory of Treatment



Note. This theory of treatment diagram illustrates the relationship between independent, dependent, and mediating variables in the intervention study.

Appendix E

Evaluation Summary Matrix

Indicator	Role of Indicator	Data Source(s)	Frequency	Data Analysis
RQ1: Was the design thinking intervention implemented and delivered as intended?				
Participation in 1 design thinking trainings	Indicator (adherence)	Faculty members participating in intervention	1 time per group (8 hours of training)	A spreadsheet was used to record attendance at the trainings.
Participation in design thinking bi-weekly sessions	Indicator (dose)	Faculty members participating in intervention	Bi-weekly (6 total meetings)	A spreadsheet was used to track attendance at the meetings
Engagement in design thinking process during meetings (participant responsiveness)	Indicator (participant responsiveness)	Faculty members participating in intervention	Bi-weekly (6 total meetings)	Facilitator used a checklist of design thinking practices to track tools used during sessions.
Use of design thinking strategies in between bi-weekly sessions (responsiveness)	Indicator (participant responsiveness)	Faculty members participating in intervention	Bi-weekly (5 total times)	Facilitator used spreadsheet to track participant design thinking activities prior to sessions 2-6.
Participant awareness of transformational leadership practices	Indicator (adherence)	Faculty members participating in intervention	1 time at the end of the intervention	Participant self-report using online survey
Participant awareness of PLC/CoP Elements	Indicator (adherence)	Faculty members participating in intervention	1 time at the end of the intervention	Participant self-report using online survey
RQ2: To what degree did participants find the treatment to be useful? • *What do participants report as key strengths and weaknesses to the design thinking approach during the innovation process?* • *What do participants report as key barriers to the design thinking process during the innovation process?* • *What do participants report as factors that helped them to be successful when using the design thinking approach at Gates School?*				

Perceived usefulness of intervention	Indicator (participant responsiveness)	Faculty members participating in intervention	1 time (end of intervention)	Semi-structured interviews with team members at end of intervention.
RQ3: Were there group differences in reports of CSE and WTR from the beginning to the end of the design thinking intervention? *RQ4: Were there group differences in teachers' perceptions of climate of psychological safety, climate of innovation, and knowledge sharing from the start to finish of the design thinking intervention?* *RQ5: Did teachers' perceptions of climate of psychological safety, climate of innovation, and knowledge sharing mediate the association between participation in the intervention and CSE and WTR?*				
Creative Self-Efficacy	Dependent Variable	Creative Self Efficacy Scale (Tierney & Farmer, 2002)	Pre- and post-tests	Descriptive and inferential statistics compared within and across treatment and comparison groups.
Willingness to Take Risks	Dependent Variable	Willingness to Take Risks Scale (Dewitt, 2006)	Pre- and post-tests	Descriptive and inferential statistics compared within and across treatment and comparison groups.
Climate of Psychological Safety	Mediating Variable	Climate of Psychological Safety Scale (Edmondson, 1999)	Pre- and post-tests	Descriptive and inferential statistics compared within and across treatment and comparison groups.
Climate of Innovation	Mediating Variable	Climate for Innovation Measure (Scott & Bruce, 1994)	Pre- and post-tests	Descriptive and inferential statistics compared within and across treatment and

				comparison groups.
Knowledge Sharing	Mediating Variable	Knowledge Sharing Behavior Scale	Pre- and post-tests	Descriptive and inferential statistics compared within and across treatment and comparison groups.

Appendix F

Intervention Group Interview Questions

1) To what extent have you benefitted from using the design thinking process over the past three months? What did you like about the process?
    - Sample follow-up question if not addressed by above question: To what extent did the use of this strategy on the team help you and your peers to innovate or take risks?
2) What challenges came up when you and/or the team were using the design thinking process to innovate?
    - Was there anything you did not like about the process?
3) Were there any factors on the team, or in the environment, that helped you to be successful as you used the design thinking process?
4) In what ways do you think design thinking could be a helpful practice for educators in K-8 schools?
    - How do you think this practice could be used at Gates School?

Appendix G

Quantitative Scales

Willingness to Take Risks Scale (Dewett, 2006)

1) When I think of a good way to improve the way I accomplish my work, I will risk potential failure to try it out.
2) I will take a risk and try something new if I have an idea that might improve my work, regardless of how I might be evaluated.
3) I will take informed risks at work in order to get the best results, even though my efforts may fail.
4) I am willing to go out on a limb at work and risk failure when I have a good idea that could help me become more successful.
5) I don't think twice about taking calculated risks in my job if I think they will make me more productive, regardless of whether or not my efforts will be successful.
6) Even if failure is a possibility, I will take informed risks on the job if I think they will help me reach my goals.
7) When I think of a way to increase the quality of my work, I will take a risk and pursue the idea even though it may not pan out.
8) In an effort to improve my performance, I am willing to take calculated risks with my work, even if they may not prove successful.

Risk Propensity (Dewett, 2006)

1) When I have more than one option for a task, I tend to choose the riskiest one.
2) I tend to take risks in work that requires highly technical analysis.
3) I tend to take more risks when decisions are more important to the organization.
4) I take risks in my work even when it is possible that they could backfire.
5) I will take risky action even when I lack all relevant information for the task at hand.

Creative Self-Efficacy Scale (Carmeli & Schaubroeck, 2007)

1) At work, I am able to achieve most of the goals I have set for myself in a creative way.
2) When facing difficult tasks (at work), I am certain that I will accomplish them creatively.
3) In general, I think that I can obtain outcomes (at work) that are important to me in a creative way.
4) I believe I can succeed at most any creative endeavor (at work) to which I set my mind.
5) I believe in my ability to overcome many challenges (at work) creatively.
6) I am confident in my ability (at work) to perform creatively on many different tasks.
7) Compared to other people (at work), I can do most tasks creatively.
8) Even when things are tough (at work), I can perform quite creatively.

Psychological Safety Scale (Edmondson, 1999)

1) If you make a mistake on this team, it is often held against you.

2) Members of this grade level team are able to bring up problems and tough issues.
3) People on this grade level team sometimes reject others for being different.
4) It is safe to take a risk on this grade level team.
5) It is difficult to ask other members of this grade level team for help.
6) No one on this grade level team would deliberately act in a way that undermines my efforts.
7) Working with members of this grade level team, my unique skills and talents are valued and utilized.

Knowledge Sharing Scale (Chennamaneni, 2006)

1) I share factual knowledge with my grade level teammates
2) I share work experiences with my grade level teammates.
3) I share know-how or tricks of the trade from work with my grade level teammates.
4) I share expertise from education or training with my grade level teammates.

Climate for Innovation Survey (Scott & Bruce, 1994)

Subscale A
1) Creativity is encouraged here.
2) Our ability to function creatively is respected by the leadership.
3) Around here, people are allowed to try to solve the same problems in different ways.
4) This organization can be described as flexible and continually adapting to change.
5) Around here, a person can get in a lot of trouble for being different.
6) The organization is open and responsive to change.
7) In this organization, we tend to stick to tried and true ways.
8) The organization publicly recognizes those who are innovative.

Subscale B
1) There are adequate resources devoted to innovation in this organization.
2) There is adequate time available to pursue creative ideas here.
3) Personnel shortages inhibit innovation in this organization.

Appendix H

Training and Session Descriptions

Session	Group 1 Activities*	Group 2 Activities*
Training	Group members learned about design thinking (DT) process from external consultant. They practiced design-thinking protocol by building an ideal new wallet for a partner and solving a problem for a fictitious superhero.	Group members learned about design thinking (DT) process from external consultant. They practiced design-thinking protocol by building an ideal wallet for a partner and solving a problem for a fictitious superhero.
Session 1	Group members practiced using the DT process again by constructing a better morning routine for a partner. Afterwards, they identified a problem they hoped to resolve though the process at Gates (kindergartner challenges in the cafeteria lunch line).	Group members practiced using the DT process again by constructing a better morning routine for a partner. They also identified a problem they hoped to resolve though the process at Gates (the first grade student transition from recess back into school).
Session 2	Using data gathered in between sessions, the group used DT practices to brainstorm and prototype a solution to K lunch line problem.	Using data gathered in between sessions, the group used DT practices to brainstorm and prototype a solution to 1st grade recess transition problem.
Session 3	After trying out prototypes prior to session, teams used DT to examine what aspects of initial prototype worked and failed. They brainstormed additional prototypes for future experimentation.	After trying out prototypes prior to session, teams used DT to examine what aspects of initial prototype worked and failed. They brainstormed additional prototypes for future experimentation.
Session 4	Team developed plan to connect school's maker space to an existing science unit on building structures. Team members used DT techniques to interview one another to discuss what challenges might come up with project.	Team developed plan to connect school's maker space to a series of lessons that required 1st grade students to build an ideal lunchbox for a partner. Team members used DT techniques to interview one another to discuss what challenges might come up with project.
Session 5	After initiating the maker space activity prior to session, the group used DT to address challenges that came up and prototyped solutions.	After initiating the lunch box maker space activity prior to session, the group used DT to address challenges that came up and prototyped solutions.
Session 6	DT was used to address problems that came up as maker space activity was implemented. The facilitator processed the overall experience with participants.	DT was used to address problems that came up as maker space activity was implemented. The facilitator processed the overall experience with participants.

*Both groups were combined during the training. They met with their individual groups for the remaining session.

Appendix I

Author's Curriculum Vitae

EDUCATION:

Johns Hopkins School of Education, Baltimore, MD
Doctoral Candidate, 2015-Present (Expected graduation: July, 2018)
Entrepreneurship in Education Leadership Concentration

Harvard Graduate School of Education, Cambridge, MA
MEd., 2003
Program: Teaching and Curriculum/Secondary History Teacher Education

Brandeis University, Waltham, MA
B.A. Magna Cum Laude with Honors, 1999
Major: History, Minor: Economics

SCHOOL EXPERIENCE:

Gates School, 9/14-6/2017
Vice Principal
- Assisted Principal with the administration of a diverse and highly respected K-8 school
- Evaluated and supervised 22 teachers across 9 grade levels
- Provided support services and behavior management supports to students in grades K-8
- Facilitated search teams that interviewed and hired 7 teachers
- Played leadership role in efforts to develop new online referral system
- Assisted team of educators to build a maker space in the school's library.
- Worked collaboratively with school and district instructional leaders to narrow achievement gaps
- Served on school leadership, crisis, child study, and grade level curriculum teams

Conant High School, 9/07-6/14

Social Studies Teacher
- Taught medieval world history and global leadership to 9th, 10th, 11th, and 12 grade students
- Developed new Psychology curriculum for 12th grade students
- Served as faculty member on school legislature and advisor of Model UN and Cambodia Clubs
- Mentored new faculty member and supervised several pre-practicum students
- Co-facilitated working group examining how to restructure the senior year
- Co-facilitated Dean's team examining lack of homework productivity at the 9th grade level.

Co-Founder and Director, Conant Cambodia Partnership
- Founded school-based nonprofit to raise money for construction of middle school in rural Cambodia

- Raised $50,000 for educational development in Cambodia and student trips to SE Asia
- Organized and facilitated student trips to Cambodia in February 2012, 2013, and 2014
- Served as Chairman of the Board on Conant Cambodia Partnership Board of Directors
- Managed budget for organization

Co-Program Leader, Global Leadership Academy
- Founded Global Leadership Academy at Conant High School after proposal was selected for funding by 21st Century Fund
- Developed and taught innovative curriculum and leadership experiences to selected students in multi-grade classes
- Published article on inception of district's 21st Century Fund in Phi Delta Kappan (Green, 2012)

Elm City College Preparatory School (Public School), New Haven, CT, 9/06-6/07
Social Studies Teacher
- Taught world civilizations, American history, geography, and health to 5th, 6th, and 7th graders at urban charter school
- Served as head of social studies curriculum development for three grade levels
- Developed and taught school's first sexual education curriculum to 7th grade students

Goleta Valley Junior High School, Goleta, CA, 9/03-6/06
Social Studies Teacher/Coordinator of House Program
- Taught world history to 7th and 8th grade students in gifted, honors, "college prep," and English language development classes
- Served on leadership, diversity, student study, and school site budget teams
- Selected as member of four-person pilot interdisciplinary team to develop curriculum for common cohort of students
- Coordinated four dances and community service drives (book, food, and disaster relief drives)
- Served as head coordinator for student leadership on campus, which included the planning, development, and implementation of dances, community service drives, and lunch activities.
- Developed a week-long international festival to celebrate school's diversity and promote global awareness
- Directed school-wide House Program, mobilizing all students and staff into small social communities to promote positive school climate
- Published article on development of Social House program in Educational Leadership magazine (April 2006) and consulted multiple schools on how to build a similar system

OTHER WORK/VOLUNTEER EXPERIENCE:

Conant Historical Society, 9/08-9/10
Board of Directors
- Worked with town officials and community members to preserve and share the town's history.

Harvard Business School, Boston, MA, 9/00-6/02
Research Associate

- Assisted several professors with the research and writing of case studies and books.
- Contributed to the development of HBS course materials by performing data analysis, library and internet research, exhibit design, and on-site interviews with organizational leaders

PUBLICATIONS:

Green, D. G. (2012). Investing in high school. *Phi Delta Kappan*, *93*(8), 28-33. Retrieved from http://pdkintl.org/publications/kappan/

Green, D. G. (2006). Welcome to the House System. *Educational Leadership*, *63*(7), 64-67. Retrieved from http://www.ascd.org/publications/educational-leadership